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# BULLETINS

# of the

# AGRICULTURAL EXPERIMENT STATION

# UNIVERSITY OF OKLAHOMA

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## BULLETINS 50-63

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1901-1904

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# Oklahoma Agricultural Experiment Station.

BULLETIN NO. 50.

APRIL, 1901.

# MANURING THE SOIL.

JOHN FIELDS.

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STILLWATER, OKLAHOMA.

# Oklahoma Agricultural and Mechanical College, Agricultural Experiment Station.

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EXPERIMENT STATION, Stillwater, Oklahoma.

# MANURING THE SOIL.

JOHN FIELDS.

## SUMMARY.

Without going into detail as to the various considerations that may affect the results of manuring, at the present stage of our agricultural practice, the chief points to be observed in manuring are:

1. To manure the soil. Use all of the manure produced, prevent losses by washing away, quit burning straw, haul manure onto the fields somewhere, sometime, somehow.
2. Manure the highest and poorest spots, give a good application at one time—from fifteen to twenty two-horse loads—and manure another place next time.
3. Manure with reference to the time of rainfall, to the next crop which is to be grown, and to the other work which must be done. Late fall and winter, when other work is not pressing, is a good time. Light top-dressings may be applied to wheat in the fall.
4. Growing crops for green manuring alone is not the most profitable method. Pasture them and plow under the remainder when about mature. This applies chiefly to cowpeas. If sorghum is to be plowed under, it should be while the stalks are green and juicy so that they will decay quickly.

## INTRODUCTION.

The tendency everywhere in cultivating new soil has been to pay but little or no attention to the conservation and improvement of fertility. It is customary to refer to the fertility of new soils as 'limitless, unbounded, and inexhaustible'. Enthusiasts speak of the vast natural fertility of the soils and many who till the soil come to believe what they hear and give no heed to facts and the teachings of experience. This bulletin is issued in the hope that it may call to mind the really great opportunities for soil improvement possessed by Oklahoma farmers, and to partially clear away some of the difficulties that have appeared in the way of the use of farm manures.

## SOIL FERTILITY.

By soil fertility is meant, in a general way, its productiveness—its ability to produce a paying crop. Variations in the degree of fertility produce variations in the crops produced. Soil fertility depends upon three things:

1. The supply of moisture. Soils may be either too wet or too dry to produce a crop. They may be too hard or too loose, too coarse or too fine, and thus unable to retain sufficient moisture for crop production.
2. The mechanical condition. Texture, ease of working, tilth, cold, warm, are general terms referring to mechanical condition. The available supply of moisture is greatly affected by the mechanical condition of the soil.
3. The supply of plant-food. By this is meant the chemical elements which are removed from the soil by plants and which must be present in the soil for crops to be grown and matured. Nitrogen, potash, and phosphoric acid are the principal substances constituting plant-food. (A brief explanation of the function and nature of these substances is given in Okla. Bulletin No. 32 and in the Annual Report for 1899.)

It is not the purpose of this bulletin to argue for the practice of manuring and to present a case in its defense. It is a fact that the application of manure to the soil is essential to continued, successful crop production, and those who dispute this fundamental principle, as a principle, will find nothing of interest in what follows.

The application of manure, on the other hand, is a matter that should be investigated by every farmer and results that seem peculiar are often produced and are difficult of explanation.

## MANURING.

Under this general head are two subdivisions:

1. The use of manure produced by animals and of refuse material such as straw, corn stalks and the like.
2. Green manuring, or plowing under of all or part of a crop grown either solely for this purpose or in part for pasture.

The effect of the application of manure of any sort to the soil is to modify the supply of plant-food, the mechanical condition, and the capacity for holding moisture. In practically all cases, the supply of plant-food is increased and a larger amount of it is placed at the disposal of succeeding crops. The mechanical condition, and consequently the capacity of the soil for water, is altered. For a time, until the soil settles and rains fill it with moisture after plowing, the effect may be harmful. After this condition is met, the results are usually beneficial.

It is upon this point that the profitable manuring of Oklahoma soils hinges. The time of application in reference to the periods of ample rainfall and to cultural methods determines whether or not beneficial results will be secured the first season. And since in farm operations, immediate results largely determine opinions of methods, it is thought by some that manuring is not profitable.

## EXPERIENCE OF FARMERS.

Among the questions included in an inquiry concerning the experience of farmers in the raising of wheat (Reported in Okla. Bulletin No. 47) was the following: "What has been the result of manuring wheat ground?" To this inquiry, 52 out of 118 reported trials with manure, thus implying that the other 66 had not tried it on wheat land. Six of the 52 reported unfavorable results from using manure on wheat.

The following are the condensed statements of those reporting adversely:

> "Manured ground grows too much straw; not as good." "Bad results." "I think the land better for wheat without manure while it is new." "Heavy manuring has not proven a success here (Cleveland County) causing too rank straw and, in nearly every instance, late maturing and rust." "Manure on fresh land causes wheat to fall and rust." It makes too much straw and does not fill."

The following are the condensed statements of those who have good results from using manure on wheat:

> "Results better in second year; too much straw the first." "Good results from manure." "Good results from manuring." "Manuring light after wheat is sowed has given best results." "Sometimes it does not do well to manure too heavy." "Light manuring is good, heavy makes the wheat fall." "Heavy manuring makes too much straw." "Have manured some hard spots with good results. "Good results." "Good results." "Will increase yield one-half if proper amount is used." "Have manured a few patches with good results." "Light top-dressing with stable manure increased yield." "It makes a large increase in the crop." "Manured three acres last

year and think wheat was two bushels better on it." "Good results; would not manure too heavy." "Manured thin land with fifty per cent increase in yield." "Good results." "Better yield." "Manure is all right if not too heavy." "On hard land it is all right" "Manuring is all right but there is not enough of it done." "Good results." "Tried small area, great success." "Very good results." "Good results." "Good results." "I have only this to say of manure—that it is the best work that I do to my wheat." "Good results." "You can't get too much. Head the wheat high and let all the litter on the ground to turn under." "Good results." "Think manuring of some kind very essential to invigorate the wheat plant." "Fresh stable manure and ashes, either from wood or straw, have paid largely for their application." "Increases the yield one-fourth." "With good results by top-dressing and working in with harrow and disk." "Manuring will increase yield one-fourth." "Top-dressing increased yields one-third, results of plowing under depend on supply of moisture. Manured ground ripens wheat earlier." "Good results." "Where manured, I get one-third more." "It pays to manure." "Paid well." "Good on land manured and plowed early." "Good results." "Farmers will have to manure their land to make wheat profitable." "Fine results." "Use all I can get with gratifying results."

When variations in seasons and soils and the rainfall and temperature of the wheat seeding season are considered, it is remarkable that the results of practical experience so strongly favor the application of manure to wheat lands. The report, "Top-dressing increased yields one-third, results of plowing under depend on supply of moisture", states the case exactly. In seasons when there is an abundant summer rainfall, manure plowed under will decay and settle down. On the other hand, in dry seasons, and especially if the soil is not well cultivated soon after plowing, manure which is plowed under will keep the soil open and make it dry out easily. The seed then goes into a dry soil, germinates poorly giving a thin stand, and starts off the wheat in a weakened condition.

This makes the manuring of land sown continuously to wheat difficult, and in such cases, it would appear that a top-dressing, well worked into the surface of the soil, would be the best and safest practice.

## RESULTS AT THE STATION.

The following table taken from Bulletin No. 47 of this station is inserted, being of interest in this connection. An acre has been sown continuously to wheat since 1892. During the first six years, no manure was applied. In the summer of 1898, 15,720 lbs. of stable manure were applied to the south half of the acre and in 1899, another application of 11,350 lbs. of well-rotted stable manure was put on. Both halves of the acre were treated exactly alike in all other respects. The yields for the last four years were as follows:

WHEAT, HALF ACRE PLATS.

| YEAR | Plat No. | YIELD PER ACRE | | Treatment |
|---|---|---|---|---|
| | | Grain Bu. | Straw Tons | |
| 1896-97 | 1 | 17.8 | 1.13 | Unmanured |
| | 2 | 17.9 | 1.14 | Unmanured |
| 1897-98 | 1 | 7.0 | .57 | Unmanured |
| | 2 | 7.5 | .66 | Unmanured |
| 1898-99 | 1 | 30 6 | 1.65 | Manured |
| | 2 | 12.0 | .68 | Unmanured |
| 1899-00 | 1 | 36.8 | 2.50 | Manured |
| | 2 | 18.1 | 1.17 | Unmanured |

In each case where manure was applied, the land was plowed in July and kept well-worked until seeding time. Figured on a cash basis, with wheat at fifty cents per bushel, thirteen and one-half tons of manure produced an increased yield of wheat amounting to a little more than eighteen and one-half bushels worth $9.25. The residual effect on the soil was such that no manure was applied last fall and it is safe to assume that less than one-half of the benefit from the use of the manure has yet been realized.

The results of manuring wheat land have been discussed rather fully for the reason that the use of manure on wheat presents peculiar difficulties and possibilities of loss during the first season.

## MANURING AND CROP ROTATION.

When a succession of crops is grown, the problem of manuring the soil is much simpler than when wheat is the sole crop. Greater opportunities are afforded for choice in the matter of time of application of manure, and there is less possibility of loss because of the drying of the soil. There is practically no danger of loss by leaching when manure is applied in the winter in this climate, and the soil is usually sufficiently dry so that loads may be readily drawn through the fields. It is thus possible to put manure on land that is to be used for corn, cotton, Kafir corn, castor beans, and other spring crops. If the land is plowed early, the spring and early summer rains will settle the soil and lessen the danger which exists when manure is applied in a dry time of the year. Another factor favoring winter manuring is the more comfortable working temperature at that time of the year and the lack of urgent work that must be done.

As the use of manure becomes more general, discussions as to the best time to apply manure will arise and experiments to test this point will be made. At present, however, the great need is that farmers generally should save and use the manure produced on the farms and put it on the soil. It now matters little when or how—the one great thing is to form the habit of using the manure that is produced in the towns and on the farms.

## SOURCES OF MANURE.

As previously indicated, anything that grows on the farm and is in such condition as to decay and become a part of the soil is classed as manure. The passing of feed through animals does not add anything in the way of fertility. When grain and forage are fed, about three-fourths of the plant-food which was in the feed is excreted either in the dung or urine, the amounts varying with the kind of animals. The location of the feed lot should be such that this plant-food can be saved and returned to the soil. Expensive arrangements for the prevention of leaching and loss of plant-food are not necessary. But the manure pile should not be located in a draw, or on the bank of a creek where each rain will wash away valuable plant-food. A level spot or a small alkali spot make ideal places for the storing of manure until such time as it can be hauled into the fields.

Corn and cotton stalks and other rubbish in the fields are easily cut down and plowed under. This method requires but little more labor than raking together and burning and adds much to the fertility of the soil. When such material is dragged together and burned, both the nitrogen and the organic matter are lost, and both are greatly needed for the perpetuation of soil fertility.

Wheat straw instead of being burned should be used as much as possible and converted into manure to be returned to the soil for the benefit of future crops. It should never be burned.

Farmers near cities and large towns can procure large quantities of manure for only the labor of hauling it. Manure from livery stables is usually very rich, only a small amount of straw being used, and heavy grain feeding being the usual custom. The only difficulty with which the experiment station has met in procuring manure from stables in Stillwater has been inability to haul it away fast enough. It has been a grand opportunity to get something for nothing and the station has taken advantage of it and manured portions of the farm so that they are now in a high state of fertility. Other portions have been left unmanured for comparison, but if the farm were conducted for profit, all of it would have been manured.

### GREEN MANURING.

The chief object of green manuring, or plowing under of crops, is to increase the supply of organic matter in the soil and to improve its mechanical condition. Some plants when plowed under actually increase the store of plant-food in the soil. These are known as leguminous crops and those that are successfully grown in Oklahoma are cowpeas, soy beans, peanuts, and alfalfa. The first of these is best suited for green manuring, but it is preferable to pasture the cowpeas off before turning them under. This can be done successfully by sowing cowpeas after wheat as described in the Annual Report for 1900, page 49.

Some very sandy soils have been benefited by growing a crop of sorghum and plowing it under after it has attained nearly full growth. The land should, of course, not be planted to crops immediately after plowing under a heavy crop of sorghum.

### SOIL EXHAUSTION.

As frequently considered, soil exhaustion is taken to mean lack of plant-food caused by continuous cropping without manure. It means much more than that, and includes a change in mechanical condition which hinders the growth of crops. This is brought about in many cases by the loss of organic matter. The failure of a soil to produce a satisfactory crop does not argue that there is a deficiency in the supply of plant-food in the soil.

The application of manure to the soil of the station farm produced such marked results that an experiment was begun last season to determine whether or not the benefit was entirely due to the plant-food in the manure, or was in part produced by the change in the mechanical condition brought about by the organic matter in the manure. No definite results have yet been secured but the indications of the work up to this time are that the application of plant-food in the form of chemicals does not produce as satisfactory results as when applied in barnyard manure.

But few Oklahoma farmers have a thorough appreciation of the extent to which commercial fertilizers are used in the eastern and central western states. The use of artificial manures is crowding westward and many farmers in Iowa, Missouri, and eastern Kansas find their use necessary. It is not the intention to even suggest the desirability of using commercial fertilizers in Oklahoma, except possibly by gardeners and growers of small fruits. On the other hand, the evil day should be put off by caring for and using farm manures while the soil is yet comparatively new. Carelessness in such matters is nothing short of vicious.

## WHEN TO MANURE.

As has been indicated, the time of manuring should bear some relation to periods of greatest rainfall. The following tables give the average monthly, seasonal, and annual rainfall of nineteen stations in Oklahoma and Indian Territories, calculated from data furnished by C. M. Strong, Section Director, Oklahoma City, Okla.

### FALL AND WINTER RAINFALL.

AVERAGE OF NINETEEN STATIONS,

| October | November | December | January | February | March | Total |
|---|---|---|---|---|---|---|
| 2.64 | 2.02 | 2.09 | 1.79 | 1.12 | 2.11 | 11.79 |

### SPRING AND SUMMER RAINFALL.

AVERAGE OF NINETEEN STATIONS.

| April | May | June | July | August | September | Total |
|---|---|---|---|---|---|---|
| 2.92 | 4.93 | 3.84 | 4.50 | 2.53 | 2.27 | 20.99 |

Of a total average rainfall of 32.76 inches, 20.99 inches or nearly 65 per cent falls during the months from April to September inclusive. This fortunate distribution of rainfall is the controlling factor in crop production in Oklahoma, and requires study so as to manure without loss the first season.

Generally speaking, manuring of the wheat crop is difficult because of the need of saving all of the soil moisture for the germination of the wheat. And as a general rule, if it is possible to do otherwise, wheat should not immediately follow the plowing under of manure. Green manuring may precede almost any spring crop, for the reason that this process usually diminishes the number of weeds. But applications of stable manure should, in most cases, be followed by some clean culture crop.

If cowpeas are grown for pasture and green manuring, they may follow wheat, being planted as soon as the wheat is cut. They will furnish considerable pasture during the late summer and fall, and may be plowed under during the late fall or winter. The land will then be in condition for a crop of oats, to be followed again by wheat and cowpeas. Stable manure may be hauled into the fields during the fall and winter, and applied to land that is to be used for corn, cotton, castor beans, Kafir corn, sorghum, broom corn, and similar crops.

## SOIL MOISTURE.

Attempts to follow Kafir corn or sorghum with wheat have very often resulted in failure. "Kafir corn ruins the land" is an expression frequently heard in conversation with farmers. When the matter is studied, it is found that, after all, it is largely a question of the supply of moisture in the soil. Kafir corn grows a large mass of forage and uses the soil moisture up until the time of wheat seeding, and the wheat goes into a soil without sufficient moisture for the germination of the seeds and the growth of the plants.

Early plowing of land for wheat does little but prepare the soil so that it will take in water and keep it. Working the soil, keeping the surface loose, helps out a dry season by holding the water in the soil. Cultivation at the proper times is much to be preferred to manuring when there is no opportunity for the soil to fill with moisture before a crop is to be planted. The effect of a given crop on the moisture content of the soil has more to do with the yield of the next crop than does the amount of plant-food removed from the soil.

Cultivation and manuring—as much as possible of each—and study and knowledge of the true effect of different crops on available soil moisture are essential to a profitable and improving system of farming. The day of crop failures, worn out farms, and purchase of fertilizers should be put off by the use of things at hand that cost only energy, time, and labor to utilize and possess.

# Oklahoma Agricultural Experiment Station.

BULLETIN NO. 51.

DECEMBER, 1901.

# FEEDING COTTONSEED MEAL TO HOGS.

F. C. BURTIS.
J. S. MALONE.

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STILLWATER, OKLAHOMA.

# Oklahoma Agricultural and Mechanical College Agricultural Experiment Station.

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EXPERIMENT STATION, Stillwater, Oklahoma.

# FEEDING COTTONSEED MEAL TO HOGS.

F. C. BURTIS AND J. S. MALONE.

## SUMMARY.

1. In this experiment where weanling pigs were kept in small pens and fed a grain ration containing one-fifth cottonseed meal and four-fifths corn meal, one-fourth to one-half of the number died after being fed the ration five to seven weeks; those living and fed the above ration, continuously and alternately with corn meal, were fattened with most excellent results.

2. The amount of grain required to produce a pound of gain was practically the same with the pigs getting cottonseed meal as it was with the pigs getting middlings, but was much less than that required by the pigs getting corn meal. The pigs getting one-fifth cottonseed meal and four-fifths corn meal alternating with corn meal, required 34.5 per cent. less grain to produce a pound of gain than the pigs did that were getting only corn meal for their grain.

3. More economical gains, disregarding losses caused by death, were obtained by feeding rations containing cottonseed meal than by feeding either corn meal or a mixture of corn meal and wheat middlings. With corn meal worth 53.5 cents per cwt., wheat middlings, 90 cents, and cottonseed meal $1.00 per cwt., the gain of the pigs getting one-fifth cottonseed meal and four-fifths corn meal alternating with corn meal cost 23.5 per cent less than the pigs getting two-thirds wheat middlings and one-third corn meal (84 days). The cost of the gain of the corn meal fed pigs was a trifle more than that of those getting middlings in their ration, but the outcome of the former should be considered a failure and unprofitable while the latter was a success and profitable.

## INTRODUCTION.

This is a subject that has been investigated by several agricultural experiment stations, but it is far from exhausted and demands further investigation. Nine farmers out of ten at the present time have the idea that cottonseed meal is not a desirable or safe feed for hogs under any conditions. In Professor Henry's late book, "Feeds and Feeding," the subject of cottonseed meal for pigs is concluded by the following quotation: "There is no profit whatever in feeding cottonseed in any form, or cottonseed meal, to hogs of any age." This is from a bulletin published some years ago by a southern station. It is not a statement in accordance with the results of later experiments, as the results from several stations show that cottonseed meal can be fed with profit under certain conditions. These results also show that the statement that the use of cottonseed meal as a feed for hogs is attended with great danger to the life of the hog, is true only under certain conditions.

Present results show that for three weeks hogs may be fed a certain amount of cottonseed meal mixed with other grain without danger to their health and that better gains may be obtained than when corn is fed alone. Certain preliminary work indicates that cottonseed meal may constitute part of a hog's ration for the greater part of his life, with good results, but more definite results are needed on this phase of the subject. It is the latter proposition that this station has planned to investigate in a series of experiments, of which the experiment detailed in this bulletin is the first. The results of some preliminary work carried on at this station were published in the tenth annual report.

The following experiment was carried on during the winter of 1900-1901:

## PLAN OF THE EXPERIMENT.

One lot of pigs was to be fed a grain mixture consisting of one-fifth cottonseed meal and four-fifths corn meal until the pigs were grown and ready for market, provided that they did not die in the meantime. Lot 5 in this experiment was fed as above. Another lot was to be fed the same as the above for four weeks, then the cottonseed meal was to be dropped for two weeks and no grain but corn meal fed, then the former ration of one-fifth cottonseed meal and four-fifths corn meal resumed for four weeks, then corn meal returned to for two weeks, and so on until the pigs were dead or fattened. Lot 6 was fed in this manner. Another lot was to be fed nothing but corn meal to give results to compare with the mixed rations, and Lot 3 was used for this. A fourth lot was to be fed a grain ration consisting of one-third corn meal and two-thirds wheat middlings, a ration that would furnish about the same food nutrients as the cottonseed meal and corn meal mixture, but that would not endanger the life of the pigs. This ration was fed to Lot 4.

The pigs used in the experiments were sixteen shoats, parts of several litters, farrowed on the college farm late in the fall of 1900, making the pigs about eleven weeks old at the beginning of the experiment. January 11. In size they varied but little, and were thrifty and fair in quality. All were sired by a Poland China boar; part were out of grade Poland China sows, and the rest out of some cross bred Duroc-Jersey Poland China sows. The sixteen were divided into four lots of four pigs each. The following table gives the weight of each pig at the beginning of the experiment and other matters of interest. The weights given are the average weights on January 10, 11 ane 12, 1901.

TABLE I.

*Initial weights Jan. 11; sex and breeding of pigs.*

| LOT 3. | | | | LOT 4. | | | | LOT 5 | | | | LOT 6 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. | Wt. | Sex | Dam | No. | Wt. | Sex | Dam | No. | Wt. | Sex | Dam | No. | Wt. | Sex | Dam |
| 46 | 38 | B | D-J<br>P-C | 39 | 59 | B | G P<br>C | 45 | 50 | S | D-J<br>P-C | 49 | 33 | B | D-J<br>P-C |
| 50 | 43 | B | G P<br>C | 53 | 37 | B | G P<br>C | 47 | 43 | B | P-C<br>D J | 54 | 44 | B | G P<br>C |
| 41 | 51 | B | G P<br>C | 52 | 46 | B | G P<br>C | 48 | 25 | B | D-J | 51 | 53 | B | G P<br>C |
| 40 | 53 | S | G P<br>C | 55 | 41 | B | G P<br>C | 42 | 67 | B | G P<br>C | 38 | 55 | S | G P<br>C |

### MANAGEMENT AND CARE.

Each lot of pigs had an open pen 9x24 feet, and a space 8x8 in an enclosed piggery. The latter was kept well bedded with straw. Cob charcoal, wood ashes and salt were kept in boxes in the pens at all times, and the pigs ate freely of these. Nothing but water was given for drink. . The feeding was done at a regular time twice a day, 6 a. m. and 5 p m. As fed, all of the grain was mixed with enough water to make a thick slop. During the first part of the experiment the policy was to feed the pigs all the grain they would eat up before the next feed. Most of the lots consumed very heavy rations, and at times there would be a little waste to weigh back. During the latter part of the experiment it was the policy to feed them light, and they were always quite hungry for the next feed, and the results were much better. From January 14 to April 1 each lot was fed two pounds of sugar beets per pig per day. These were greatly relished by the pigs. In all the lots the pigs very frequently would leave the grain to go and eat beets. During the experiment the lots ate the following amounts of sugar beets and a mixture of cob charcoal, wood ashes and salt.

| | Sugar Beets eaten Pounds | Mixture of Charcoal, ashes and salt, fed, Pounds |
|---|---|---|
| Lot 3—4 pigs | 696 | 302 |
| Lot 4—4 pigs | 696 | 287 |
| Lot 5—2 pigs | 348 | 199 |
| Lot 6—3 pigs | 464 | 247 |

At the beginning and the ending of the experiment, each pig was weighed on three consecutive days, and on two consecutive days at the ending of each two weeks' period, and one week from these weighings each lot was weighed. Where more than one weight was taken, they were averaged, and the average taken for the ending or beginning weights of a period. For instance the weights given for January 11, are averages of weights on January 10, 11 and 12. This is to obliterate the daily variations due to other causes aside from the gains that the pigs made. The lots were very even in weight and make-up at the beginning of the experiment January 11.

The pigs in Lot 3 were fed no grain but corn meal up to April 5. After this they received the same mixture of grain and treatment as Lot 6; during the first four weeks following April 5, one-fifth cottonseed meal, four-fifths corn meal, then two weeks corn meal. Lots 4, 5 and 6 were fed as planned. Lot 6 was fed the cottonseed meal and corn meal mixture for the first four weeks of the experiment, and then corn meal two weeks and so on as planned. Aside from what is noted in Lot 3 no more changes were made in the plans of any of the lots. The change in the ration of Lot 3 was made because the lot was doing very poorly and two individuals in the lot would never have fattened on the former ration without a change of conditions. After a few weeks the pigs getting nothing but corn meal showed little appetite for their grain. At one time, during the sixth period, March 22, to April 5, the pigs in Lot 5 which were fed continuously on cottonseed meal and corn meal, seemed to tire of their grain and ate poorly, but after these two weeks of indifference, their appetites returned and they were ready for a full feed. Aside from the above, all the pigs ate well during the experiment and seemed to relish the feed.

### RESULTS OF THE EXPERIMENT.

Table II gives the individual weights of the pigs, and grain eaten per lot, for the bi-weekly periods and the gain per pig for 126 days. The partially blank columns are the results of those pigs dying.

TABLE II.

*Showing feed eaten per lot and weight of pigs for bi-weekly period.*

LOT 3, FED CORN MEAL.

| Date | WEIGHTS OF PIGS LBS. | | | | Total grain eaten |
|---|---|---|---|---|---|
| 1901 | No. 46 | No. 50 | No. 41 | No. 40 | Lbs |
| Jan. 11 | 38 | 43 | 51 | 53 | |
| Jan. 25 | 43 | 49½ | 65½ | 67½ | 144 |
| Feb. 8 | 44½ | 58 | 71½ | 76½ | 150 |
| Feb. 22 | 49 | 63 | 77 | 85 | 154 |
| Mch. 8 | 54 | 68½ | 85½ | 94½ | 163 |
| Mch. 22 | 59 | 74 | 95½ | 101½ | 168 |
| Apr. 5 | 63 | 79½ | 103 | 108½ | 168 |
| Apr. 19 | 75 | 95 | 122 | 122 | 168 |
| May 3 | 83½ | 99½ | 137 | 133½ | 168 |
| May 17 | 94 | 109 | 149½ | 145½ | 190 |
| Net gain | 56 | 66 | 98½ | 92½ | ...... |

Average gain, 78.55.

LOT 4, FED ⅓ CORN MEAL, ⅔ MIDDLINGS.

| WEIGHTS OF PIGS LBS. | | | | Total grain eaten |
|---|---|---|---|---|
| No. 39 | No. 53 | No 52 | No. 55 | Lbs. |
| 59 | 37 | 46 | 41 | ......... |
| 74 | 53 | 63 | 56½ | 144 |
| 84 | 64 | 77 | 72 | 180 |
| 92 | 75½ | 89½ | 84 | 196 |
| 106 | 91 | 109 | 96 | 212 |
| 122½ | 106½ | 127 | 116 | 280 |
| 137½ | 125 | 145 | 127 | 280 |
| 144 | 135 | 158 | 139 | 280 |
| 169 | 156½ | 178½ | 156½ | 280 |
| 192½ | 185½ | 201½ | 182½ | 302 |
| 133½ | 148½ | 158½ | 141½ | .............. |

Average gain, 145.5.

LOT 5, FED FOUR-FIFTHS CORN MEAL, ONE FIFTH COTTONSEED MEAL

| Date | WEIGHTS OF PIGS LBS. | | | | Total grain eaten |
|---|---|---|---|---|---|
| 1901 | No. 45 | No. 47 | No. 48 | No 42 | Lbs. |
| Jan. 11 | 50 | 43 | 25 | 67 | .... |
| Jan. 25 | 65 | 57 | 34½ | 89 | 72 |
| Feb. 8 | 81½ | 72½ | 44 | 114½ | 94½ |
| Feb. 22 | 95 | 84½ | dead | dead | 189 |
| Mch. 8 | 113 | 101½ | ........... | ........ | 106 |
| Mch. 22 | 127½ | 111½ | ........... | ........ | 110 |
| Apr. 5 | 140 | 123 | ........... | ........ | 98 |
| Apr. 19 | 156 | 139 | ........... | ........ | 120 |
| May 3 | 176½ | 150 | ........... | ........ | 126 |
| May 17 | 190 | 173 | ........... | ........ | 148 |
| Net gain | 140 | 130 | ........... | ........ | ........... |

Average gain, 135.

LOT 6, (For feed see Note II)

| WEIGHTS OF PIGS LBS. | | | | Total grain eaten |
|---|---|---|---|---|
| No. 49 | No. 54 | No. 5 | No. 38 | Lbs. |
| 33 | 44 | 53 | 55 | ............... |
| 44½ | 52½ | 70 | 74 | 72 |
| 57 | 70 | 88 | 93½ | 102 |
| 61 | 77 | dead | 101 | 122 |
| 76 | 94 | ................. | 125½ | 142 |
| 91 | 109 | ................. | 146½ | 188 |
| 96½ | 118½ | ................. | 163½ | 182 |
| 114 | 136 | ................. | 184 | 189 |
| 128½ | 150 | ................. | 193 | 182 |
| 145½ | 163½ | ................. | 226 | 204 |
| 112½ | 119½ | ................. | 171 | ............ |

Average gain 134.

NOTE II.—Grain fed Lot 6, given in Tables III and IV. (Cottonseed meal and corn meal.)

Pig No. 51 in Lot 6 died February 15, p. m.; in Lot 5 No. 41, died February 20, p. m.; and No. 48 February 20, during the night. Pig No. 51 in Lot 6 had been changed from the cottonseed meal–corn meal mixture that it had received for four weeks, to pure corn meal for one week previous to its death. Pigs Nos. 41 and 48 in Lot 5 had received the cottonseed–corn meal mixture for a little less than six weeks prior to their death. The feeding as first planned with Lots 5 and 6 was continued and the rest of the pigs lived and did well.

The small gain of Pig 41 in Lot 3 should be noticed, as it is about half of the average of the lot. The poor results were not due to sickness, but improper feed and conditions for a small growing pig. Pigs of the same size and type in the other lots made regular gains. Under adverse conditions the smaller pigs always suffer more than the larger, more thrifty ones.

### RESULTS BY PERIODS.

### TABLE III.

*Giving gains, grain eaten, and grain required for gains.*

| BI-WEEKLY PERIODS. | LOT 3. | LOT 4. | LOT 5. | LOT 6. |
|---|---|---|---|---|
| | Fed Corn Meal | Fed one-third Corn Meal two-thirds Middlings | Fed four-fifths Corn Meal one-fifth Cottonseed Meal | Fed four-fifths Corn Meal one-fifth Cottonseed Meal* |
| January 11 to 25—Average per pig. Period I.—14 days. | | | | |
| Gain, pounds | 9.85 | 15.85 | 15.15 | 14.15 |
| Daily gain, pounds | .70 | 1.13 | 1.08 | 1.01 |
| Grain eaten, pounds | 36 | 36 | 36 | 36 |
| Lbs. grain eaten for 1 pound gain | 3.65 | 2.27 | 2.37 | 2.54 |
| January 25 to February 8.—Average per pig. Period II—14 days. | | | | |
| Gain, pounds | 6.50 | 12.65 | 16.70 | 16.70 |
| Daily gain, pounds | .46 | .93 | 1.19 | 1.19 |
| Grain eaten, pounds | 37.50 | 45 | 44.80 | 49.50 |
| Lbs. grain eaten for 1 pound gain | 5.77 | 3.55 | 2.68 | 2.96 |
| February 8 to 22—Average per pig. Period III.—14 days. | | | | |
| Gain, pounds | 5.90 | 13.50 | 12.75 | 7 |
| Daily gain, pounds | .42 | .96 | .91 | .50 |
| *Grain eaten, pounds | 38.50 | 49 | 49 | 44.75 |
| Lbs. grain eaten for 1 pound gain | 6.52 | 3.63 | 3.84 | 6.39 |
| February 22 to March 8—Average per pig. Period IV—14 days. | | | | |
| Gain, pounds | 7.10 | 12.85 | 17.50 | 18.40 |
| Daily gain, pounds | .51 | .98 | 1.25 | 1.31 |
| Grain eaten, pounds | 40.70 | 53 | 50.50 | 47.30 |
| Lbs grain eaten for 1 pound gain | 5.73 | 4.12 | 2.89 | 2.57 |
| March 8 to 22—Average per pig. Period V—14 days. | | | | |
| Gain, pounds | 6.90 | 17.40 | 12.25 | 17 |
| Daily gain, pounds | .49 | 1.24 | .87 | 1.21 |
| Grain eaten, pounds | 42 | 70 | 55.50 | 63 |
| Lbs. grain eaten for 1 pound gain | 6.09 | 4.02 | 4.53 | 3.71 |
| March 22 to April 5—Average per pig. Period VI—14 days. | | | | |
| Gain, pounds | 6 | 14.75 | 12 | 10.60 |
| Daily gain, pounds | .43 | 1.05 | 86 | .76 |
| *Grain eaten, pounds | 42 | 70 | 49 | 60.60 |
| Lbs. grain eaten for 1 pound gain | 7 | 4.75 | 4.08 | 5.72 |

*During Periods 3 and 6, Lot 6 was fed corn meal.

Table III gives the average results per pig for the first six bi-weekly periods of the experiment. The results per pig are given instead of the results per lot for the reason that some of the lots, after the first few weeks, have one or two pigs less per lot than others. The fact that some of the pigs were dropped out because of death would not strictly admit of the results being compared, but since the pigs were fairly uniform in make-up in each lot at the start, the comparisons between lots on the average basis are allowable for practical purposes. After the ending of the second period two pigs are considered in Lot 5, and three in Lot 6. This table gives in detail in two–week periods, what is given as a whole in Table IV, but there are some facts shown in Table III that are not shown in Table IV. Note the gains made and the grain required to make one pound of gain by Lot 6 in Periods 1 and 2, when they were receiving four-fifths corn meal and one-fifth cottonseed meal, and how the gains drop, and the amount of grain required to produce a pound of gain goes up, in Period 3, where they were on pure corn meal. The gain is less than half as much as that of the preceding two weeks and the grain used to produce a pound of gain was more than double. In the following period when the lot was returned to the cottonseed meal–corn meal mixture the gains went up again to the former standard. When the corn meal was returned to again in the sixth period there was a drop in gains again, but not as marked as in Period 3. And when the cottonseed meal–corn meal mixture was returned to in Period 7 (see Table V), the normal gains were again obtained, which were eight pounds more than when the pigs were getting corn meal in Period 6. In Table III the gains of Lot 5 are shown to have varied from period to period more or less, but not any more than the other lots. Up to the fourth period Lots 4 and 5 were eating about the same amounts of grain, but in the fifth and sixth period Lot 4 ate more than Lot 5. And in these last two periods Lot 6 ate considerably more grain than Lot 5. About this time Lot 5 showed signs of being tired of its rations, but later got over it. The uniformly poor gains of Lot 3 that received corn meal are clearly shown.

### SUMMARY OF RESULTS UP TO APRIL 5.

Table IV gives a summary of the bi-weekly results given in Table III. The results are the average per pig. Lots 4, 5 and 6 had obtained a very good weight in the 84 days, weighing 134, 132 and 127 pounds respectively, and had made 88, 85 and 82 lbs. gain. It is seen that there is but very little difference in the gains made by these lots, Lot 4 leading by six pounds over Lot 6, and three pounds over Lot 5. These three lots would have sold for light hogs at this time. In the matter of gains Lot 3 had made about half the gains made by the other lots. Two of the individuals were in a very scrawny condition, but the other two were making progress slowly. There was considerable difference in the amount of grain consumed by Lots 4, 5 and 6. Lot 4 ate the most, 22 lbs. per pig more than Lot 5, and 48 pounds per pig more than Lot 6, which compared with the gain made, gives Lot 5 the best standing as to the amount of grain required to produce a pound of gain. The cost of the gains made by these lots varies more than the other results, due to the difference in prices of the feed. The market price of these feeds for the winter of 1900-1901 were taken: Corn meal 53.5 cents per cwt; middlings 90 cents per cwt, cottonseed meal $1.00 per cwt. Excepting Lot 3 the gain of Lot 4, receiving the corn meal and middlings cost the most, 2.85 cents per pound; that of Lot 6, that received the mixture of four-fifths corn meal and one-fifth cottonseed meal for two-thirds of the time and corn meal for one-third of the time, cost next highest, 2.18 cents per pound; that of Lot 5 that received a continuous ration of four-fifths corn meal and one-fifth cottonseed meal cost least, 1.95 cents per pound. The grain required to produce a pound of gain in Lot 3 was very high for pigs of that size, but the cost of gain is not very much above that of some of the others, due to the low price of corn at that time.

TABLE IV.

| | LOT 3 | LOT 4. | LOT 5. | *LOT 6. |
|---|---|---|---|---|
| JANUARY 11 to April 5—84 days. | Fed Corn Meal | Fed one-third Corn Meal and two-thirds Middlings | Fed one-fifth Cottonseed Meal and four-fifths Corn M'l | Fed one-fifth Cottonseed Meal and four-fifths Corn M'l |
| Average per Pig. | Pounds | Pounds | Pounds | Pounds |
| Weight April 5 | 83.5 | 133.75 | 131.50 | 126.50 |
| Gain, pounds | 42.25 | 88 | 85 | 82.16 |
| Daily gain | .50 | 1.04 | 1.01 | .98 |
| Grain eaten | 236.75 | 323 | 285.80 | 301.15 |
| Grain eaten per day | 2.81 | 3.84 | 2.72 | 3.53 |
| Grain required to make 1 lb. gain | 5.60 | 3.67 | 3.37 | 3.66 |
| Cost of grain to make 1 lb. gain | 2.99 | 2.85 | 1.95 | 2.18 |

*Every two weeks following four weeks, corn meal alone, see Table III.

## CLOSING THE EXPERIMENT.

Table V contains data similar to that in Table IV and the results follow those given there. The change of the feed of Lot 3, that received corn meal in Tables III and IV, to the cottonseed meal-corn meal mixture in Table V, should be noticed. Otherwise the feeds used, and the plans followed were the same as those given in Table III. In period 9, in this Table, note that the gains of Lots 3 and 6 receiving corn meal were considerably better than those in period eight where they received the cottonseed meal-corn meal mixture. That there was no drop in the gains here, when the pigs were put on corn meal, may be explained by the fact that the pigs were about mature, as the older the pig the less the importance of a nitrogenous feed, such as cottonseed meal, for them But in this table, Period 7, the advantage of changing Lot 3 from corn meal on April 5, (see period 6, Table III), to the cottonseed meal mixture, is clearly shown. In Period 6 the small gain of Lot 3 is very noticeable. As can be seen by the feed eaten, they were eating regularly. The weekly gain, not shown there, was very small. For the two weeks period, one of the pigs, No. 46, given in Table II, made only four pounds gain. No disease was present in the lot and nothing wrong could be seen, except their stunted and scrawny condition.

### TABLE V.

| BI-WEEKLY PERIODS. | LOT 3. | LOT 4. | LOT 5. | LOT 6. |
|---|---|---|---|---|
| | * Fed four-fifths Corn Meal and one-fifth Cottonseed Meal | Fed one-third Corn Meal and two-thirds Middlings | Fed four-fifths Corn Meal and one-fifth Cottonseed Meal | * Fed four-fifths Corn Meal and one-fifth Cottonseed Meal |
| **April 5 to 19—Average per Pig. Period VII—14 days.** | | | | |
| **Gain, pounds** | 15 | 10.25 | 16 | 18.50 |
| **Daily gain, pounds** | 1.07 | .73 | 1.14 | 1.32 |
| **Grain eaten, pounds** | 42 | 70 | 60 | 63 |
| **Lbs. grain eaten per lb. of gain** | 2.80 | 6.82 | 3.75 | 3.41 |
| **April 19 to May 3—Average per Pig. Period VIII—14 days.** | | | | |
| **Gain, pounds** | 9.90 | 21.10 | 15.75 | 14.56 |
| **Daily gain, pounds** | .71 | 1.51 | 1.13 | 1.04 |
| **Grain eaten, pounds** | 42 | 70 | 63 | 60.60 |
| **Lbs. grain eaten per lb. of gain** | 4.24 | 3.32 | 4 | 4.19 |
| **May 3 to 17—Average per Pig. Period IX—14 days.** | | | | |
| **Gain, pounds** | *11.10 | 26.15 | 18.25 | * 18.54 |
| **Daily gain pounds** | .79 | 1.87 | 1.16 | 1.32 |
| **Grain eaten, pounds** | 47.50 | 75.50 | 74 | 68 |
| **Lbs. grain eaten per lb. of gain** | 4.28 | 2.89 | 4.05 | 3.67 |

*During Period 9, Lots 3 and 6 were fed corn meal.

Table VI gives the results of Table V condensed. No radical change can be seen in the results of Lots 4, 5 and 6 from those given in Table IV. The lots continue about equal in weight. All continued to thrive and it is remarkable that there was scarcely any increase in the grain required to produce a pound of gain in the last forty-two day of the experiment over that required during the first eighty-four days of the experiment. The cost of gain remained about the same as for the first eighty-four days of the experiment. Note that during this period of forty-two days when Lot 3 received the cottonseed meal mixture, that the gains required but 3.42 lbs of grain to produce each pound of gain, and cost but 1.95 cents, while for the eighty-four days (see Table IV) during which time they were fed corn meal, it required 5.6 lbs of grain to produce a pound of gain at a cost of 2 99 cents, and by the change it was made possible to fatten the hogs. At the close of the experiment, May 17, two pigs of Lot 3 were in marketable condition and two were not. All the pigs in Lots 4, 5 and 6 were well finished and made a fine showing. The two pigs of Lot 3, that were not in a marketable condition, were fed for twenty-seven days longer on different feeds in a large lot, and made an average gain of 56 lbs. during that time. The feed cost $1.15 apiece.

TABLE VI.

| APRIL 5 TO MAY 17—42 days. | *LOT 3. | LOT 4. | LOT 5. | † LOT 6. |
|---|---|---|---|---|
| | Fed one-fifth Cottonseed M'l and four-fifths Corn Meal | Fed one-third Corn Meal and two-thirds Middlings | Fed one-fifth Cottonseed M'l and four-fifths Corn Meal | Fed one-fifth Cottonseed M'l and four-fifths Corn Meal |
| Average Per Pig | Pounds | Pounds | Pounds | Pounds |
| Weight May 17 | 124.50 | 191.25 | 181.50 | 178.33 |
| Gain, pounds | 38.50 | 57.50 | 50.50 | 54.83 |
| Daily gain | .92 | 1.37 | 1.19 | 1.30 |
| Grain eaten | 131.5 | 215.5 | 197 | 191.6 |
| Grain eaten per day | 3.13 | 5.13 | 4.69 | 4.56 |
| Grain required to make 1 lb. gain | 3.42 | 3.74 | 3.94 | 3.49 |
| Cost of grain for 1 lb. of gain | 1.95 | 2.91 | 2.47 | 2.08 |

*For four weeks, then corn meal alone for two weeks.

†Pure corn meal part of the time, see Table V.

The market price of fat pigs on May 17, 1901 was $4.70 per cwt. Two representative pigs of each lot were slaughtered. All of the internal organs were found normal. A local butcher substantiated our judgment in that all the meat was first class. A difference could be seen between some of the lots but of no practical value. If there was any difference it was in favor of the cottonseed meal fed hogs. The butcher was surprised to find the walls of the intestines of all the hogs entirely free from worm holes, that are almost always present in those of the average hog. We attribute this partially to the charcoal, ashes, and salt that the pigs ate. Worms in hogs are a great drawback to good gains.

### COST OF THE GAINS.

Summing up the results for all the periods including 126 days, the following results per pig are obtained:

### TABLE VII.

*Summary for 126 days, per pig.*

| Lot No. | Weight May 17 | Gain in 126 days | Daily gain | Grain eaten | Grain eaten per pound of gain | Cost of grain | Cost of gain per lb (grain only) |
|---|---|---|---|---|---|---|---|
| | Pounds | Pounds | Pounds | Pounds | Pounds | Dollars | Cents |
| Lot 3 | 124.5 | 78.3 | .62 | 368 | 4.70 | 2.04 | 2.61 |
| Lot 4 | 191.3 | 145.5 | 1.15 | 539 | 3.70 | 4.18 | 2.87 |
| Lot 5 | 181.5 | 135.0 | 1.07 | 483 | 3.57 | 3.03 | 2.24 |
| Lot 6 | 177.7 | 133.7 | 1.06 | 493 | 3.68 | 2.93 | 2.14 |

From the above it can be seen that a very fair profit was realized upon Lots 3 and 4, and on Lots 5 and 6 if the dead pigs are not taken into account. All of the pigs that died were examined, but no special effort was made to discover the reason why the cottonseed meal killed the pigs. The characteristic symptoms and results of pigs dying from eating cottoneeed meal were observed in the case of each pig that died. Another pig in Lot 6 gave early symtoms of cottonseed meal affection, but recovered. It did not interfere with his eating. The pigs that died ate right up to the time of death in a regular manner. Death takes place in about twelve hours after the first symptoms and in many cases in two or three hours.

The results from this experiment may be used as guides at present, and when they are compared with the results of other experiments of a similar nature now under way at this station, and others planned for the near future, more definite conclusions can be arrived at.

In studying the results the fact should be borne in mind that these pigs were under unfavorable circumstances, restricted to small pens when young. If these pigs had had a wheat pasture to run on, and had been given a light grain ration for about 60 to 90 days, then put on a full feed of grain, the gains probably would have cost a third less. It is not the most economical as a rule to feed weanling pigs a full grain ration. It is the opinion of the writers, based upon preliminary work in this line at this station, that had Lots 5 and 6 been running on green pasture and been fed a rather light grain ration for the first half of the experiment, that no pigs would have died. (See Tenth annual report, page 102 )

As a rule pigs do not die when fed a grain ration containing cottonseed meal if the cottonseed meal is not continued longer than four weeks, although it sometimes happens that they do. No case has come under the notice of the writers where a pig has died if the cottonseed meal mixture has not been continued longer than three weeks. As a rule, if small pigs are shut up in a small pen, and fed a grain mixture containing cottonseed meal to the amount of one-fourth to one-fifth, all the pigs will die inside of eight to ten weeks. But this experiment, and others elsewhere, show that there are exceptions to this. From preliminary work done by this station, and other work under way, it looks as if a ration containing from one-fifth to one-tenth cottonseed meal may be fed in light rations for an indefinite time, if the pigs are running on a green range.

In such a year as the fall of 1901 when corn is very high priced and wheat worth 65 cents per bushel there will be a great advantage in feeding some cottonseed meal to hogs, if proper precautions are followed. The following recommendations have been given by this station and are followed with our hogs at the present time. (Fall of 1901.)

Don't add more than one-fifth cottonseed meal to the grain ration.

Feed rather a light grain ration.

After feeding the ration containing the cottonseed meal for two or three weeks, drop the cottonseed meal for two or three weeks, after which return to the cottonseed meal mixture for a like duration to be followed by the omission of the cottonseed meal as before.

Endeavor to let the pigs have range and green feed at the same time.

At the present time we consider that the above directions may be followed without danger of losing any pigs, but our future experiments may prove differently.

Oklahoma Agricultural Experiment Station.

BULLETIN NO. 52.

DECEMBER, 1901.

# THE POTATO CROP.
# VARIETY TESTS OF CABBAGE.

O. M. MORRIS.

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STILLWATER, OKLAHOMA.

# Oklahoma Agricultural and Mechanical College,

# Agricultural Experiment Station.

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# THE POTATO CROP.

O. M. MORRIS.

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## COMMERCIAL POTATO GROWING.

The largest district of commercial potato growing in Oklahoma is confined to the valley of the North Canadian river in Pottawatomie county. The soil in this district is well adapted to producing an early crop of potatoes and the work has been taken up by active, up-to-date farmers and pushed to its present high standing. It is now one of the best paying crops of that district. There are two crops grown each year, an early or spring crop, and a late or fall crop.

The soil of this district is a sandy loam and is an ideal potato soil. The subsoil is porous, containing a large proportion of sand. This insures good drainage and makes the land work easily and warm up early in the spring, which is a very essential feature for the spring crop. The clay loam lands will produce almost as large crops of potatoes but they will be later in season than those on sandy soil.

There is not much difference in the methods of planting and cultivation followed by the different growers. All the growers have almost the same kind of soil, grow the same variety of potatoes, and for the same market. They are all striving to attain the same results, a large crop at an early date; and for this reason they follow practically the same process in growing a crop. This fact also accounts for the success of most of the growers.

The land is plowed in the fall or early winter when preparing for the early crop. This gives the soil time to settle and catch the winter rains and prepare for the drouth that usually comes in March and April. This drouth catches most of the early crop just as it is coming up and the young plants are beginning to depend on their own roots for food. If the plants are not supplied with moisture at this time many will die and those living will be greatly weakened, even though plenty of rain should fall later on. This fall plowing keeps the soil in better condition and avoids turning under two or three inches of dry surface to help injure the crop. Deep plowing has uniformly given the best results.

## PLANTING.

The planting is done as soon as danger of hard frosts and freezes is past. This is about from the middle of February to the first of March. There are frosts later than this but they are seldom heavy enough to harm potatoes. There has been some planting done in January but it has not proven to be any better and is but little if any earlier in maturing the crop than later planting. In some of the earlier plantings last spring the potatoes started into growth and the vines were killed back to the surface of the ground by frost, but came up again and made a good crop.

Most of the planting is done with planters. The potatoes are cut about two eyes to the piece and the pieces are dropped from twelve to eighteen inches apart in rows about three feet apart. The potatoes are planted about two inches below the surface of the soil. The soil is then ridged up over the row until the seed is covered four to six inches deep. The earlier the planting is done the more the rows are ridged. This is done to protect the seed from the cold and hasten sprouting.

The seed used for this planting is that produced by the second crop of the previous year, or else it is shipped in from the north. The seed from the previous spring crop is sometimes used but has not given as good results as either the fall crop or the imported potatoes. The first crop of potatoes is difficult to keep over the summer on account of rot, and those that escape the rot dry and wither until they make very poor seed potatoes. The Bliss Triumph is the only variety grown to any extent for shipping. This is a very early, medium-sized, red potato. Its special merit lies in its earliness and productiveness.

## CULTIVATION.

The cultivation begins with smothing down the ridges over the potato row as soon as the potatoes begin sprouting and before they are up. This work is done with a light harrow or drag that will work down the ridges and not disturb the seed. The subsequent cultivation is level and shallow, forming a dust mulch on the surface of the ground without breaking and destroying the roots of the plants. The cultivation is just frequent enough to keep the land free from weeds and the soil in good condition. The soil is gradually worked to the rows again and the last cultivation forms a distinct ridge about three or four inches high along the row. The cultivation is discontinued when the young potatoes are about a half inch in diameter. Cultivation later than this does no good and in some instances has done actual damage. The rows are sometimes cleaned with the hoe and this is about all of the hoe work that is done.

### HARVESTING.

The crop is harvested while the potatoes are still green and growing. The chief object is to put the crop on the market at the earliest possible date. The digging is done with potato diggers and plows. The potaoes are simply thrown to the surface of the soil and gathered up by hand. The sorting is done in the field as the potatoes are gathered up. The marketable ones are placed in sacks and immediately taken to market. The culls are thrown to one side and covered with soil to protect them from the sun until they can be planted for the second crop.

### THE SECOND CROP.

The culls from first crop form the seed for the second crop. The largest ones are usually cut about two eyes to the piece for planting and the smaller ones are planted whole. This seed sprouts very slowly on account of its being so green when dug and planted. The growth from this seed is very uneven, but this fault is overcome to a large extent by planting a large quantity of seed. Sometimes the seed rots badly, and gives a poor stand; when this happens the largest and ripest potatoes decay first and the smaller ones last.

The planting for the second crop is done during the last of June and the first of July. The method of planting and cultivating the second crop does not differ much from that of the first crop. The crop is usually allowed to mature before harvesting.

### YIELDS.

The first crop yields from eighty to one hundred or more bushels of marketable potatoes per acre. Last summer most of this crop sold for from fifty to seventy-five cents per bushel delivered on the cars of the Choctaw, Oklahoma & Gulf railroad. The growers estimate the entire cost of the crop placed on the cars at ten to seventeen dollars per acre. This leaves a good profit for the grower. The second crop does not usually make as large yields but a higher price is usually received for the crop. This crop, however, is well worth the growing if it only makes seed for the following spring crop.

Diseases and insects have done no noticeable harm as yet, and have not forced any thought or demand for spraying apparatus. The nature of the crop makes it convenient to crop the same land with potatoes year after year. This will rapidly reduce the value of the land for potato growing and hasten the spread of such diseases as scab and blight, after they are once started in the field. Some other crop should be grown on the land every other year. Such crops as corn, or wheat and cowpeas make good rotations with potatoes.

### VARIETY TESTS.

A test of varieties of potatoes has been carried on at the station for the last two years. The land used in this test is a light upland loam. The seed was cut two eyes to the piece and planted two pieces to the hill, hills eighteen inches apart in rows three feet apart. The patch was given clean, shallow cultivation until the young potatoes were about one-half inch in diameter and then all cultivation ceased. The seed was all northern grown. The potatoes were all dug as soon as mature. The crop of 1901 was taken to the cave as soon as dug and placed in small boxes. The temperature of the cave ranged between 72 and 80 degrees Fahrenheit during July and August.

The following table gives the names and yields of the varieties grown. The potatoes of the crop of 1901 that were put in the cave were counted when placed in the cave and again on August 21 and September 24. The rotten potatoes were thrown out each time and from these counts the per cent. of rotten potatoes was estimated:

| NAME | 1900 | | 1901 | | |
|---|---|---|---|---|---|
| | No. of Bushels Per Acre | Per Cent of Crop Marketable | No. of Bushels Per Acre | Per Cent of Crop Marketable | Per Cent of Crop Rotten Sept. 24 |
| Acme | ........ | ........ | 78 | 63.6 | 7 |
| Beauty of Hebron | 82 | 50 | 52 | 64.2 | 16 |
| Bliss Triumph | 66 | 80.9 | ........ | ........ | ........ |
| Bovee | 56 | 40 | 44 | 47.9 | 1 |
| Burbank | 54 | 42 9 | 31 | 36.9 | 2 |
| Burpee's Extra Early | 58 | 57.6 | 94 | 61.3 | |
| Burpee's Superior | 59 | 57 | ........ | ........ | ........ |
| California Russet | 45 | 62.3 | ........ | ........ | ........ |
| Carmen No. 1 | 121 | ........ | 30 | 69.3 | 6 |
| Carmen No. 3 | 94 | ........ | 52 | 79.8 | 10 |
| Country Gentleman | ........ | ........ | 26 | 66 | 13.7 |
| Early Six Weeks | 213 | 82.4 | 69 | 56.4 | 3 |
| Early Rose | 123 | 62.8 | 61 | 63.3 | 10 |
| Early Kansas | 96 | 52.8 | 71 | 58.7 | 27 |
| Early Ohio | 90 | 49.3 | 83 | 63.4 | 5 |
| Early Fortune | ........ | ........ | 111 | 62.7 | 1 |
| Early Norther | 39 | 32.3 | ........ | ........ | ........ |
| Early Pingree | ........ | ........ | 47 | 46.4 | 11 |
| Early Puritan | 49 | 27.7 | ........ | ........ | ........ |
| Empire State | 92 | 95.5 | ........ | ........ | ........ |
| Extra Early Vermont | 108 | 57.1 | ........ | ........ | ........ |
| Great Divide | 95 | 42.1 | ........ | ........ | ........ |
| Good News | ........ | ........ | 105 | 60.7 | 9 |
| Ideal | 16 | 57.1 | ........ | ........ | ........ |
| Irish Cobbler | 161 | 80.7 | ........ | ........ | ........ |
| Joseph | ........ | ........ | 18 | 30.3 | 29 |
| Maggie Murphy | 72 | 69 | ........ | ........ | ........ |
| Rural New Yorker | 93 | 52.9 | 39 | 60.8 | 13 |
| Secretary Wilson | ........ | ........ | 97 | 44.2 | 11 |
| Sir Walter Raleigh | 23 | 40 | 43 | 49.7 | |
| State of Maine | 77 | 67.8 | 60 | 56.7 | |
| State of Wisconsin | ........ | ........ | 28 | 32.9 | |
| Thoroughbred | 139 | ........ | 101 | 35.1 | |
| Vigorosa | ........ | ........ | 66 | 66.6 | |
| World's Fair | ........ | ........ | 35 | 14 | |
| White Star | 116 | ........ | 79 | 68.9 | |
| White Beauty | ........ | ........ | 48 | 39.3 | |

## NOTES ON VARIETIES.

*Acme;* small; short oblong, thick; eyes medium to large; skin pink, a little rough; very early.

*Beauty of Hebron;* large; oval; eyes few, shallow; skin white; early.

*Bliss Triumph;* medium to large; round, or a little flat; eyes deep; skin red; very early.

*Bovee;* medium to large; oblong, thick; eyes shallow; numerous; skin yellowish white with pink markings; early.

*Burbank;* medium size; long; eyes small; skin white; midseason.

*Burpee's Extra Early;* medium size; oval; eyes few, small; skin rose color; very early.

*Burpee's Superior;* large; long oval; eyes few, small; skin white; midseason.

*California Russet;* large; long; eyes few, medium size; skin white, covered with russet; late.

*Carman No. 1;* a little above medium size; broad oval, flattened; eyes few, medium size; skin white; midseason.

*Carman No. 3;* medium to large; broad oval, flattened; eyes few, medium size; skin white; late.

*Country Gentleman;* medium to large; oblong to long, flattened; eyes large, shallow; skin pink; late.

*Early Six Weeks;* medium size; round; eyes deep; skin rose color; very early.

*Early Rose;* medium size; oval to long; eyes medium size; skin rose color; early.

*Early Kansas;* medium size; long oval; eyes medium size; skin white, a little russet; early.

*Early Ohio;* medium size; oval; eyes medium size; skin light rose color; very early.

*Early Fortune;* large; oblong; eyes few, medium size; skin white; early.

*Early Norther;* medium to large; oblong; eyes large, deep; skin white; early.

*Early Pingree;* medium size; oval to long; eyes few, small; skin white; early.

*Early Puritan;* medium to large; oval; eyes large, shallow; skin white; early.

*Empire State;* very large; long; eyes large, deep; skin white; late.

*Extra Early Vermont;* large; round to oval; eyes large, shallow; skin light rose; early.

*Great Divide;* large; oblong, slightly flattened; eyes small; skin white; midseason to late.

*Good News;* large; long, cylindrical; eyes shallow; skin smooth, white; late.

*Ideal;* small; long, slightly irregular; eyes few, small; skin light red; early.

*Irish Cobbler;* medium size; short, oblong; eyes medium deep; skin white; midseason.

*Joseph;* medium size; oval; eyes small; skin red; late.

*Maggie Murphy;* medium size; broadly oval; eyes few, medium size; skin light rose, netted; late.

*Rural New Yorker No. 2;* medium size; oblong, usually pointed; eyes few, shallow; skin white, netted; late.

*Secretary Wilson;* medium size; oval, flat; eyes large, shallow; skin white; midseason.

*Sir Walter Raleigh;* medium size; round to oval; eyes few, medium size; skin white; midseason.

*State of Maine;* large; round; eyes large, shallow; skin white; late.

*State of Wisconsin;* large; long; eyes medium size, deep; skin white; late.

*Thoroughbred;* medium size; oblong; eyes small, shallow; skin light rose; early.

*Vigorosa;* large; flat, oblong and sometimes irregular; eyes shallow; large; skin red; late.

*World's Fair;* medium size; oval; eyes shallow; skin white, very finely netted; late.

*White Star;* medium size; round to oblong; eyes medium size, shallow; skin white; late.

*White Beauty;* large; long to oval; eyes few, small, shallow; skin white; late.

## FALL AND SPRING PLOWING.

The potato growers in Pottawatomie county generally agree that their experience and observation proves that the land should be plowed in the fall before the potato crop is planted in the spring. The soil in that district is a sandy loam. The soil on the experiment station farm is a light upland soil mixed with some hard pan or clay. The results of experiments in fall and spring plowing on this soil coincide with the results on the sandy loam.

The results of several experiments along this line differ so little that the result of only one test is given. The field was divided into forty-eight plats of equal size. Twelve plats were on land that was plowed in October before the crop was planted in March. These plats made an average yield of 95.5 bushels of marketable potatoes per acre. Twelve were on land that was plowed seven inches deep and subsoiled five inches deep just before the crop was planted. These plats made an average yield of 72.5 bushels of marketable potatoes per acre. The other twenty-four plats were on land that was plowed about seven inches deep just before the crop was planted. These plats made an average yield of 73 bushels of marketable potatoes per acre.

## DEPTH OF PLANTING.

The depth at which the seed should be planted varies with the season and condition of the soil at the time of planting. In very cold or very warm weather the seed should be covered a little deeper than at other times, or if the soil is very dry the seed may be planted a little deeper than would otherwise be advisable. The yield of the plats that were planted to test this point varied from those in which the seed was planted in furrows three to four inches deep and then filled level full of soil, which was 84 bushels of marketable potatoes per acre; to those planted in furrows about eight inches deep and covered with three inches of soil which made forty-seven bushels per acre. The deep furrows were gradually filled by cultivation.

The seed should always be planted in moist soil and covered immediately. The potato planters do almost ideal work in this respect, but in small patches where the rows are laid out with a plow and the seed dropped by hand, the soil in the open furrow is dried and the sprouting of the seed retarded thereby. This can be observed every year but it is especially noticeable if the planting is done during a dry spell. Last spring potatoes planted in furrows that had been left open for one to two days and exposed to the wind, were as much as two weeks later in coming up, than those planted in fresh furrows on the same day.

## TIME OF PLANTING.

The best time for planting early potatoes varies with each season and no definite date can be named. The seed should not be planted until the soil is warm enough to start it into growth at once. If the seed lies in moist, or wet soil a week or two before growth starts, a good part of it will be destroyed by rot. Last spring, potatoes planted March 14 came up as early and matured the crop as early as those planted February 27. The crop planted about the middle of March has usually been as early as that planted in February and has made a larger yield by having a better stand of plants. On sandy soil and in the southern part of the territory, the planting can be done much earlier.

## CULTIVATION.

Shallow cultivation, frequent enough to keep down the weeds and the surface of the soil well pulverized, is best. The early cultivation should leave the land as level as possible, but later on the soil should be drawn to the row enough to make a distinct ridge. The land must be kept free of weeds and grass. Small patches of midseason and late potatoes can be mulched profitably with old hay or straw. The early crop frequently can also be mulched with profit. A comparison of the yield of cultivated and mulched plats shows greatly in favor of the mulched plats. Sixteen cultivated plats of the crop of 1899 made an average yield of eighty-four bushels of marketable potatoes per acre. Five mulched plats made an average yield of 111 bushels of marketable potatoes per acre. This was a midseason crop. The crop of 1900 gave practically the same results as that of the year before. In the crop of 1901 the mulched plats made about four times as large a yield as the cultivated plats. This, however, was an exceptionally dry season and such results are far out of proportion for the average season.

### KEEPING POTATOES.

The early potatoes usually make a fair crop and there are few questions asked about methods of planting and cultivating them. The crop of midseason and late potatoes is usually very poor. There seems to be no method of cultivation that will enable any variety of late potatoes to make even a fair crop each year. Mulching the patch with old hay or straw gives the best results. The mulch should be from six to ten inches deep when first spread on the ground.

The trouble that confronts almost every farmer in Oklahoma is, how to keep a crop of early potatoes through the summer and early fall so that he can have his own potatoes for use during the winter. This year is an extreme but it illustrates the situation all the better.

In July potatoes sold for fifty cents per bushel in Stillwater and now, December 13, they are worth $1.20 per bushel. If the farmer could have kept the early crop the price would not have been so low in July and August nor so high now. Most farmers lose a large per cent. of their potato crop each year by the rot and count on losing it. The result is that few farmers keep enough of their own crop for family use, others buy all they use during the winter and spring and many others are not using potatoes this year.

Many methods of keeping the early crop have been tried but only a few have been even partially successful. Several methods have proved quite satisfactory one year and have been entire failures the next year, and no method that can be used by the average farmer has to our knowledge given even a fair degree of satisfaction for two or three successive years.

Four different methods of keeping the potatoes through the summer in the soil where they grew have been advocated. The first and most common method attempted is to let the potatoes remain in the soil undisturbed till fall. This plan is almost regularly a failure. The potatoes are only two or three inches under the surface of the soil and are heated through till they rot. A rain in the middle or latter part of the summer will cause most of the sound ones to sprout. Last summer one plat was treated this way and when the crop was dug early in the fall eighty per cent. of the potatoes were rotten, and the remaining twenty per cent. have not kept well since then. In 1900 the loss on a similarly treated plat was somewhat less. In some plats where the weeds and grass were very thick the loss was about forty per cent.

Another method is to leave the potatoes in the ground and go through the field with a lister or turning plow and throw up a ridge over the row. This, if well done, will cover the potatoes with six to eight inches of soil. This work should be done as soon as the crop is mature. In 1900 a plat treated in this manner lost twenty per cent. of the crop before fall. In 1901 this plat lost sixty per cent. of the crop before September 1. There was no appreciable loss either year from sprouting. This plan is better than leaving the land level but is a very poor method. It has given fair results on sandy soil but even there failures are frequent.

In the third method the land is left level and about the time the last cultivation is given or shortly before the crop is mature, a row of cowpeas is drilled on either side of the row of potatoes as close as the drill can be run to the vines. The peas will make a good growth over the row and shade the land and reduce the amount of moisture in the soil during the summer. This plan was followed with two plats in the summer of 1900 and about sixty per cent. of the crop rotted. No difference could be seen between these plats and those left without any covering. In 1901 this plan was followed again and about seventy-five per cent. of the crop rotted.

The fourth method of keeping the crop in the field is to mulch the patch with straw or old hay in the spring or in the summer after cultivation has ceased. Plats mulched in the spring of 1900 and the crop dug in the fall lost by rot about five per cent. Plats treated in the same way in 1901 lost about fifteen per cent. by rot. This is by far the best of the four methods just discussed. It is a practicable method to follow on farms where potatoes are grown only for use. The potatoes kept in this way in better condition and have a better appearance than those kept through the summer in a cave. The mulched plats will on an average keep as many bushels per acre until fall as the cultivated plats will yield if dug as soon as the crop is mature.

Keeping the potatoes by packing them in sand in the cave resulted in a loss of twenty-five to fifty per cent. by rot. In the first lot the potatoes were packed in a box of sand so that no two touched each other or the sides or the bottom of the box. In the second lot each potato was wrapped in paper and then packed in the sand the same as the first lot. There was very little if any difference in the per cent. rotten in the two lots. Both lots sprouted worse than other potatoes in the cave. A few were wrapped in paper and placed in a box in the cave. This bunch lost about twenty per cent.; the same as other potatoes placed in the cave at the same time.

Quick or unslacked lime was pulverized and dusted over the potatoes, in a bin in the barn, so that every potato was covered with the fine dust. They were placed in the bin July 6, 1901, and the lime dusted on immediately. They were removed October 1, and had lost forty-one per cent. by rot. Another lot was dusted with lime in the same way at the same time and placed in the cave. This lot lost ninety per cent. by rot.

Copper sulfate (blue vitriol) was pulverized and dusted very lightly over one lot of potatoes on July 6 and they were immediately placed in a bin in the barn. This lot lost forty per cent. by rot by October 1.

Salt was pulverized and dusted over a lot of potatoes about the middle of July. They were placed in the cave where it took about four weeks for the entire lot to decay.

One lot of potatoes was coated with paraffin by dipping each one in melted paraffin. The temperature of the paraffin was 160 degrees Fahrenheit, and the potatoes were simply dipped in and lifted out immediately. This gave a very thin but practically airtight coating to each one. The potatoes were all clean and sound. The work was done in July 1901 and the entire lot decayed in two weeks.

Dipping the potatoes in Bordeaux mixture, ammoniacal copper carbonate, and formaldehyde, was tried but the results indicate that the work does more harm than good. The potatoes dipped in any one of these solutions rotted two to six times as rapidly as those not treated.

Keeping potatoes in an open shed has been advocated and practiced by some farmers. Mr. J. W. Poling of Oklahoma City says: "I kept some potatoes one year by placing them in a corn crib as soon as they were dug. The crib was well covered and so situated that the sun could not strike the potatoes. They were simply placed on the floor of the crib in early summer and left there until fall, and kept in fair condition. The second trial, however, ended in a failure."

This method was tested here and resulted in a failure. The potatoes were sorted and only the good ones used. The sound potatoes were spread about two or three deep on the floor of a small bin in a closed shed at the north end of the barn. They were not handled or moved in any way during July, August and September. When they were taken from the bin, October 1, twenty-one per cent. were rotten. A similar test in the summer of 1900 resulted in about forty per cent. rotten.

Good results have been obtained at times by piling the potatoes on straw in the shade of trees and then covering the pile with about two feet of straw. A heavy rain will cause all of the potatoes to sprout or rot. The test of this method here last summer resulted in seventy-seven per cent. of the pile rotting. The test lasted from July 6 to September 30. There was not enough rain during the summer to wet through the covering and wet the potatoes.

The average cave will not keep the crop through the summer. The Bliss Triumph lost about fifteen per cent. of those placed in the cave early in the summer in 1901. The average temperature was 73 degrees. Those that did not rot sprouted badly and are now unfit for table use. There is a great difference, however, in results, depending upon the way the potatoes are handled and stored. Those piled on the floor of the cave rotted badly, those left in sacks kept somewhat better but are in a very bad condition now. Those kept in small boxes or crates did the best and justify the statement that in good caves good potatoes may be kept through the summer with little loss of properly handled.

If the potatoes are to be stored in the cave through the summer they should be dug as soon as growth has ceased. If they remain in the ground until they are ripe their keeping qualities will be greatly impaired. This is especially true if the patch is not mulched. The potatoes that are a little green when dug keep better in caves than those that are mature. The green ones will wilt if kept in too dry a place but if the cave floor is a little moist they will keep in fair condition. They require ventilation but should not be in a direct draft of air.

The heat is no doubt the principal cause of decay. In testing this last summer, it was found that freshly dug potatoes were badly damaged by being heated to 110 Fahrenheit degrees while those that had been dug for some time and wilted a little could be heated to 120 degrees without any noticeable harm being done to their keeping qualities. Heating potatoes to 100 degrees for one hour each day did more harm than heating to 110 degrees for the same number of hours taken consecutively. Potatoes placed in closed or nearly air-tight vessels and heated to 100 degrees and left in these vessels decayed in two weeks.

The best method tested is to grow the potatoes under a mulch of hay or straw and leave them in the ground till fall. If rain should cause them to start to sprout or decay they should be dug and stored in small boxes or crates in a cave. If the patch is not mulched the crop should be dug as soon as matured and stored in a cave. The potatoes should not be left in the sun but should be taken to the shade as fast as they are dug.

# VARIETY TESTS OF CABBAGE.

O. M. MORRIS.

A variety test of cabbage has been carried on for the last two years. The plants were started in the hot bed and set in the field as soon as the conditions of the weather would permit. The plants were set three feet apart in rows three and one-half feet apart in 1900, and in rows six feet apart in 1901. The following table gives the name and yield of each variety. In 1900 twenty-five plants of each variety were set. In 1901 thirteen plants of each variety were set.

| | 1900 | | | 1901 | | |
|---|---|---|---|---|---|---|
| | No. of Heads | Total Weight | | No. of Heads | Total Weight | |
| | | Lbs. | Oz. | | Lbs | Oz. |
| North Carolina Winter | 18 | 65 | 14 | Not Planted | ........ | ........ |
| Augusta Early Trucker | 20 | 43 | 9 | Not Planted | ........ | ........ |
| Early Jersey Wakefield | 17 | 34 | 1 | Failure | ........ | ........ |
| Early Winningstadt | 5 | 4 | 6 | Failure | ........ | ........ |
| Large Early York | 10 | 15 | 1 | Failure | ........ | ........ |
| Dwarf Early York | 6 | 9 | 6 | 3 | ........ | 6 |
| Extra Early Etampes | 7 | 11 | 10 | Failure | ........ | ........ |
| Surehead | 19 | 26 | 12 | 2 | 4 | 14 |
| Early Express | 6 | 6 | 5 | Failure | ........ | ........ |
| Fottler's Impr'v'd Brunswick | 8 | 11 | 1 | Failure | ........ | ........ |
| Large Late Drumhead | 16 | 25 | 4 | 3 | 6 | 9 |
| Henderson's Early Summer | 13 | 25 | 10 | 5 | 4 | 2 |
| Allseasons | 20 | 50 | 10 | 1 | ........ | 12 |
| Premium Late Flat Dutch | 16 | 24 | ........ | 2 | 2 | 12 |
| Drumhead Savory | 2 | 1 | 5 | Failure | ........ | ........ |
| Mammoth Rock Red | 14 | 9 | 1 | 1 | ........ | 6 |
| Early Dwarf Flat Dutch | 14 | 31 | 1 | Failure | ........ | ........ |
| Mammoth Marble Head | 17 | 24 | 4 | 1 | ........ | 6 |
| Excelsior | 13 | 28 | 6 | 6 | 9 | 3 |
| World Beater | 18 | 20 | 4 | Not Planted | ........ | ........ |
| Vandergraw | 21 | 27 | 11 | Not Planted | ........ | ........ |
| Henderson's Early Summer | 20 | 32 | 15 | Not Planted | ........ | ........ |
| Lupton | 22 | 44 | 11 | Failure | ........ | ........ |
| Allhead Early | 22 | 62 | 14 | 2 | ........ | 9 |
| Henderson's Succession | 14 | 21 | 14 | Not Planted | ........ | ........ |
| Green Glazed | 1 | ........ | 12 | Not Planted | ........ | ........ |
| Safe Crop | 20 | 35 | 13 | Not Planted | ........ | ........ |
| Early Spring | 17 | 27 | 11 | Failure | ........ | ........ |
| Filderkraut | 21 | 21 | 12 | Not Planted | ........ | ........ |
| New Savory | 6 | 1 | 11 | Failure | ........ | ........ |
| Hollander | Not Planted | ........ | ........ | 3 | 2 | 6 |
| Succession | Not Planted | ........ | ........ | 2 | 1 | 6 |
| Golden Sugar Winter | Not Planted | ........ | ........ | Failure | ........ | ........ |
| Louisville Drumhead | Not Planted | ........ | ........ | Failure | ........ | ........ |
| Large Jersey Wakefield | Not Planted | ........ | ........ | Failure | ........ | ........ |

## NOTES ON VARIETIES.

*North Carolina Winter;* stem short; head nearly round, soft until almost grown; leaves large; midseason.

*Augusta Early Trucker;* stem short; head round to flat; medium firm throughout growth; rots badly at stem; midseason.

*Early Jersey Wakefield;* stem medium length; head long, conical, medium firm; sunscalds badly, decays as soon as mature; early.

*Early Winningstadt;* stem medium length; head conical, firm; sunscalds and decays badly; early.

*Large Early York;* stem medium length; head long, firm, rots soon after maturity; early midseason.

*Dwarf Early York;* stem short; head long, very firm, decays and sunscalds badly; Very early.

*Extra Early Etampes;* stem short; head long, firm; early. A good variety.

*Surehead;* stem medium length; head round or flat, firm; late. A good variety.

*Early Express;* stem medium length; head conical to round, sunscalds badly; early. Very poor.

*Fottler's Improved Brunswick;* stem short; head flat, very firm; midseason.

*Large Late Drumhead;* stem long; head flat, firm when mature; late.

*Henderson's Early Summer;* stem very short; head flat, cracks badly, but does not rot; early midseason.

*Allseasons;* stem medium length; round or slightly flattened, very firm throughout growth; late. Good.

*Premium Late Flat Dutch;* stem short; head firm, flat; stands drouth very well. A very good late cabbage.

*Drumhead Savory;* did not head.

*Mammoth Rock Red;* stem tall; head round, firm; late.

*Early Dwarf Flat Dutch;* stem medium length; head round, very firm; early; sunscalds and rots badly.

*Mammoth Marble Head;* stem medium length; head round, firm, free from rot and sunscald, late.

*Excelsior;* stem medium to long; head, round firm, free from rot; late. Good.

*World Beater;* stem medium length; head round, very firm; late.

*Vandergraw;* stem short; head round, free from sunscald and rot; late.

*Lupton;* stem long; head flat, firm; midseason; good.

*Henderson's Succession;* stem medium length; head flat, firm; midseason.

*Green Glazed;* stem long; head small. Not good. Late.

*Safe Crop;* stem short; head flat, firm; late.

*Early Spring;* stem short; head flat, firm; early.

*Filderkraut;* stem medium length; head conical; late.

*New Savory;* stem short, head very small, soft. Not good.

*Hollander;* stem tall; head small, round, firm throughout growth; late.

*Succession;* see *Henderson's Succession.*

Oklahoma Agricultural Experiment Station.

BULLETIN NO. 53.

JUNE, 1902.

# COMMON PARASITES OF DOMESTIC ANIMALS.

L. L. LEWIS.

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STILLWATER, OKLAHOMA.

# Oklahoma Agricultural and Mechanical College.

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EXPERIMENT STATION, Stillwater, Oklahoma.

# COMMON PARASITES OF DOMESTIC ANIMALS.

L. L. LEWIS.

## INTRODUCTION.

The general prevalence of parasites affecting all species of domestic animals makes it possible, by observing and experimenting with a limited number of animals, to obtain information that is of general and practical use. The presence of any great number of parasites, whether internal or external, is injurious to any animal, and their effect is soon noticeable. This is especially true of external parasites where the presence of any considerable number is indicated by a tendency of the animal to rub or gnaw the skin until in nearly all cases the result is a loss of hair, a general unthrifty condition and a tendency of the tissues to degenerate into the formation of sores and ulcers.

Very few of the domestic animals are affected with parasites to such an extent as to cause death, but this may frequently be the case. Probably this is the reason that under ordinary circumstances so little attention is paid to the presence of parasites except in special cases where certain quarantine regulations prohibit the movement of infected animals. The direct injury caused by many parasites, as the scab and mange mites, and the power of others, as the cattle tick, to carry disease, necessitate measures that will prevent their spread as well as the use of some means of ridding the animals of the parasites. The numerous other forms of parasites, while not so destructive as the forms mentioned, should receive attention as they live at the expense of the animals and impoverish them in proportion to their numbers. No perceptible injury can be seen on account of the small amount of blood taken by a few lice or flies but when this small amount is multiplied by the thousands that may infest a single animal it is sufficient to cause a noticeable loss. This loss however may be less than that caused by the tissues breaking down in such diseases as scab and mange. Such a condition of the skin as seen in the above diseases causes a heavy drain on the vitality of the animal, not only through the loss of tissue which the animal economy is continually trying to repair but also through the lack of normal function of the skin and the continual irritation caused by this condition. In the majority of cases the animal is poor in flesh, not because, as many suppose, the parasites attack by choice the poor animals, but because the presence of large numbers of parasites will soon reduce the animal to this condition.

In recent years much work has been done in studying every possible means by which diseases may be communicated from sick to healthy animals. As such investigations are completed it is found that a great number of contagious and infectious diseases may be spread through the agency of parasitic or semi-parasitic insects. This is not only true of the ability of insects to spread disease among domestic animals but they may be the means of infecting man with some of the diseases of the lower animals. The most familiar example of the power of a parasite to carry disease is that of the cattle tick to carry Texas fever. This will be dealt with more fully in the consideration of that particular parasite. Flies are known to be the means of spreading anthrax and it is very probable that they are the means in many cases of carrying blackleg infection from carcassas to healthy animals. The piercing mouth parts of the fly become infected with the germ and when they pierce the skin of healthy animals they may inoculate them directly with the disease.

No systematic classification of the parasites will be given in this bulletin, but rather the occurrence of parasites as external or internal will be considered on account of the similarity of treatment used for external forms and the general application of the same remedies for the internal parasites. Most of the external parasites belong to the group commonly called insects (flies, lice, mosquitoes, etc.) while such forms as ticks, scab and mange mites, though commonly classed as insects, belong to the group Arachnida.

Many of the insects are semi-parasitic in their habits. This is especially true of the larvael forms of the flies as in the case of the bot-fly where the larva or grub lives in various regions of the body depending on the species of animal attacked. It is found under the skin of the back in cattle, in the head of the sheep, in the stomach of the horse, and some of the flies attack the smaller animals as squirrels, etc. The injury done by bot-flies is while they are in the larvael form as they are then present in the body of some animal. The lice are parasitic during their entire life history. The eggs, commonly called nits, are attached to the hairs and after hatching, the young do not as a rule leave the host animal. One very interesting feature in regard to lice is that the same species of lice do not infect different species of animals. The hog louse will not be found on cattle or horses, and cattle lice are never found on hogs although the animals may be kept in the same enclosure. Very little is known of the rate of increase of the lice but it is probably very rapid. Examination of an animal may show only a few parasites and within a few weeks the animal may be so badly infested that they will interfere seriously with its thrift.

The life histories of all of the scab, mange and itch mites are very similar. They live either in or on the skin of the host animal and have no independent life history. The ticks pass a part of their life history apart from the host animal. The eggs are deposited on the ground and the young ticks may live for some time before becoming attached to the host animal.

A certain amount of knowledge of the habits and manner of development of parasites is necessary before any very successful means can be adopted to rid animals of them. Remedies that will be effective in one case will be of no use when applied to some other parasite. The habit of the parasite, whether completely parasitic or not, will make a difference in the remedy and the way it is applied. It is practically impossible to disinfect hog pens, cattle stalls, etc., but very few of the external parasites, with the exception of the fleas, leave the body of the animal to an extent that would make such a procedure necessary.

## BOT-FLY OF THE HORSE.

The horse probably harbors no parasite about which there is so much discussion as there is about the bot-fly; some contending that the presence of a few bots in the stomach cannot possibly be injurious while others regard them as being very dangerous and refer all digestive troubles to their presence. Every one who handles horses is familiar with the small yellow "nit" or egg found attached to the hair in the region of the leg, shoulder or jaw. The eggs are deposited by the bot-fly, or as more commonly called, the nit fly, on regions of the body where the horse can by biting and licking the skin convey them either as eggs or larvae into the mouth and stomach. Figure one is a photomicrograph of an egg showing a larvae inside. It is probable that the animals in licking themselves open the greater number of eggs by removing the cap, as shown in the figure, and the larvae are then carried to the mouth by the tongue. They pass from the mouth to the stomach where they attach themselves to the walls of this organ and when seen in this position are familiarly known as bots.

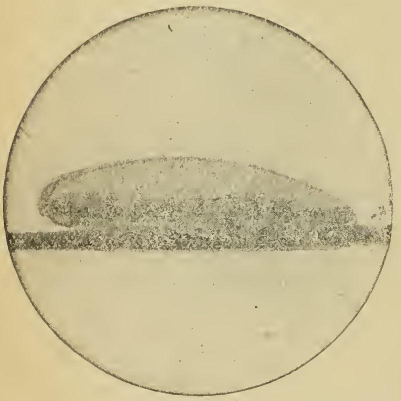

FIG. I. (GASTROPHILUS EQUI)—Photomicrograph of egg of the bot-fly of the horse.

Almost every animal that runs in pastures, and the greater number of driving horses are infected each season with the bots. In some cases where postmortems gave opportunities for examination only a few larvae were found but occasionally cases were seen where the greater portion of the walls of the stomach were covered with the larvae. Where they are present in such large numbers they necessarily interfere with the normal function of the stomach. The very nature of the case prevents any absolute determination as to whether they are injurious or not. The possibilities of injuring the horse are by interfering with the digestive function of the stomach, by the irritation caused by the presence of the bots or, when present in such large numbers, they may obstruct the passage from the stomach. In any case the possibility of injury would depend on the number of bots present, it being very probable that the presence of only a few bots is without any injury whatever. After the larvae are developed they are passed from the body after which they bury themselves in the dirt where they continue their development and finally emerge as the fully developed bot-fly.

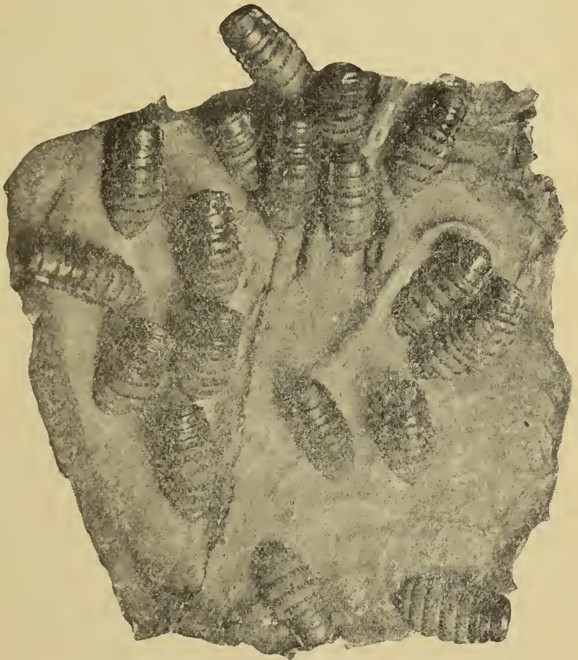

FIG. 2 Photograph of Bots attached to the walls of a horse's stomach.

As a means of prevention there is no surer remedy than thoroughly to rub the body occasionally with a brush or rag wet with kerosene. The oil will prevent the eggs from hatching and it soon evaporates leaving the skin free from grease. It is difficult to remove bots from the stomach as they withstand severe remedies. Good results have followed the use of full doses of anaesthetics, as chloroform or ether. Carbon bisulphide is probably the best remedy that can be given. This drug is very volatile and is best given in large gelatin capsules or it may be given in ice water. First fast the animal for a day then give four drachms of the carbon bisulphide every two hours until you have given three doses. This treatment should be followed with a physic of oil or salts.

### STOMACH WORMS OF CATTLE AND SHEEP.

This parasite belongs to the round worms and varies in length from one inch for the females to about half that size for the males. The color varies from dark to light red depending on the amount of blood it contains as it takes its food from the membrane lining the stomach. When present in large numbers the parasites are apt to cause serious trouble and in many cases death results from their presence. They multiply rapidly, the eggs passing out with the excrement and when washed into pools they soon hatch and gain entrance to the alimentary canal with the drinking water.

Dr. Stiles of the Bureau of animal industry recommends the use of a one per cent solution of coal tar creosote for the destruction of this parasite. Sheep may be given as much as six ounces, young cattle ten ounces and adult cattle one quart of the one per cent solution. If necessary the treatment may be repeated in a few days.

### ROUND WORM OF THE HOG.

This is the common round worm of the hog and is usually found in the small intestine. The worm is never attached and it occasionally moves forward into the stomach. The males are from four to seven inches long, the females being usually twice as long. When present in small numbers it is not likely that these worms cause any serious disturbance but as they are often seen in sufficient numbers to almost completely fill the small intestine they necessarily interfere with digestion and consequently with the growth and development of the animal.

### THORN HEADED WORM.

This is a very common parasite and can be easily distinguished from the preceding one by its size, as it is much smaller than the round worm, and also by the spiny growth at the head by which the worm attaches itself to the walls of the intestine. The place where the worm is attached can be seen from the outside of the intestine as a yellowish nodule. On opening the intestine small ulcers are seen at the point of attachment and at other places in the intestine showing that the worm frequently moves from one place to another. The worm is milky white in color and measures from seven to ten inches in length for the females and four to six inches for the males. The body shows a number of constrictions in the region of the head and tapers gradually from this region back. The effect of the worm in the intestine does not differ greatly from that of the other worm except in the local inflammation where the worm is attached.

*Treatment:* The same remedies may be used against both parasites. If hogs are allowed free access to a mixture of salt, wood ashes and sulphur they are not apt to be troubled with worms. Such a mixture is inexpensive and should be kept in the pens at all times. Turpentine or oil of worm seed (chenopodium) in thirty drop doses in a small amount of feed three times daily will soon relieve hogs of any intestinal worms that may be present.

### REMEDIES AGAINST INTERNAL PARASITES.

There is little practical value in dividing remedies against worms into vermicides, those that kill, and vermifuges, those that expel worms. It is of more importance to know that certain drugs have a selective action for certain species of worms. In considering remedies against intestinal worms remedies against bots have been included although they belong to the group of insects, being a larvael form of the bot-fly.

A number of the remedies are likely to produce symptoms of poisoning if administered in too large doses, many are irritating to the alimentary canal and may cause excessive purgation, some, as pumpkin seed and quassia, are not injurious to the animal when used in large quantities. In giving drugs some account must be taken of the age and size of the animal. The following list contains the drugs usually administered for the different intestinal parasites. The difference in the size of the dose necessary for young and adult animals is indicated. Where no dose is given the drug is not suitable for that species of animal.

| | HORSES | CATTLE | SHEEP | PIGS | DOGS |
|---|---|---|---|---|---|
| Aloes | ¾ to 1 oz. | 1 to 2 oz. | | | 20 to 30 gr. |
| Areca nut | | | 1 to 4 dr. | | 15 to 40 gr. |
| Turpentine | 2 ounces | 2 to 3 oz. | 2 to 4 dr. | 2 to 4 dr. | 1 to 3 dr. |
| Santonin | ½ to 1 oz. | 1 to 2 oz. | 1 to 2 dr. | | 10 to 30 gr. |
| Oleorsin of male fern | 1 to 2 ozs. | | 1 to 3 dr. | | 1 to 2 dr. |
| Chloroform | 1 to 4 dr. | | 1 to 2 dr. | | |
| Kousso | | | 2 to 4 dr. | 3 to 6 dr. | 1 to 2 dr. |
| Pomegranate | | | 2 to 4 dr. | | 1 to 2 dr. |
| Carbon bisulphide | ⅓ to 1 oz. | | | | |
| Pumpkin seed | | | 4 to 6 oz. | | 2 to 4 oz. |

Before giving any remedy to expel or destroy worms the animal should be fasted for at least thirty-six hours in order to have the alimentary canal partially empty. When this is done the action of the drug is not interfered with by large quantities of partially digested food. In many cases it is better to give a physic of either salts or oil to free the alimentary canal of material and then give the remedy intended to act on the worms, this may be given alone or with a small dose of physic. Where the remedy itself is a physic, as calomel or aloes, this is not necessary. With most of the remedies it is necessary to give some physic to remove the parasites from the alimentary canal. This should always be done when preparations of santonin, areca nut, male fern, kousso or pomegranate are used.

Many of the remedies have a specific action on certain worms as shown in the following list: Remedies against tape worms; areca nut, kousso, pumpkin seed, male fern and pomegranate. Remedies against round worms; areca nut, santonin, aloes, turpentine and calomel.

Any of the tonics are very beneficial in ridding an animal of parasites. Such remedies as iron, arsenic, gentian or nux vomica when continued for some time will give good results. The following preparation will be found very beneficial as a tonic after the use of any of the remedies indicated in the above list.

Sulphate of iron, six ounces.
Pulverized nux vomica, four ounces.
Common salt, one pound.
Linseed meal or bran, one gallon.

Mix the material dry. For horses and cattle give an ounce of the mixture in feed twice daily. For smaller animals as sheep, use one-fourth to one-half as much.

Remedies against the small thread-like worms that are found in the rectum must be applied directly to the parasite in the form of an injection. The presence of this worm is indicated when the animal is continually rubbing the tail, although they may do this when irritated by lice or mange mites. Of the various preparations that have been tried against these worms turpentine and quassia have given the best results. Turpentine may be used as an emulsion with milk or soap suds in the proportion of one part of turpentine to ten of the her liquid. To prepare the quassia for injection take one ounce of quassia chips and place in a half gallon of warm water and allow them to remain there for an hour. The chips are then removed and the fluid diluted to make one gallon. This diluted fluid is then used as an injection. The injection should be repeated in from three to five days.

### CATTLE LICE.

There are two species of suctorial lice found on cattle. These lice are provided with mouth parts capable of piercing the skin of the host animal and obtaining blood for their nourishment. Cattle are more frequently troubled with lice than they are supposed to be and it is a very rare thing for the stockman to undertake anything to relieve them of the parasites. During the winter and early spring months cattle are continually rubbing and showing in other ways that the skin is irritated and an examination will show the presence of lice. The eggs, commonly called nits, are attached near the roots of the hairs by some glue-like substance and are usually more easily found than the lice.

### SHORT NOSED OX LOUSE.

This species is generally found on the neck and shoulders and animals frequently rub these parts bare in their efforts to rid themselves of the parasites. This louse is larger than the one known as the long nosed ox louse and is one of the most difficult of the external parasites to destroy when it is once thouroughly established. The average size of the parasite is one-eighth to one-seventh of an inch in length with the body about one-half that in width. This parasite, so far as observations have been made here, is comparatively rare.

### LONG NOSED OX LOUSE.

This species is often confused with the preceding one as they are frequently found occurring together. In length they are about one-eighth of an inch and one-third of that in breadth, the entire body having a slender appearance as compared with the preceding parasite. The color of both species is the same, being described as blue or slate colored.

The egg, as shown in the figure, is an elongated oval body firmly attached near the root of the hair with some glue-like substance which is deposited with the egg. The specimen from which the drawing was made measured .75 mm. in length and .3 mm. in width In all of the specimens examined there was nothing but the shell of the egg found. The material examined showed no marking on the eggs as described by Osborn for the egg of the short nosed ox louse. The drawing shows several particles of foreign material that are not a part of the egg but particles left by the embryo.

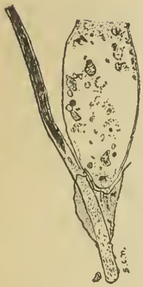

FIG. 3.

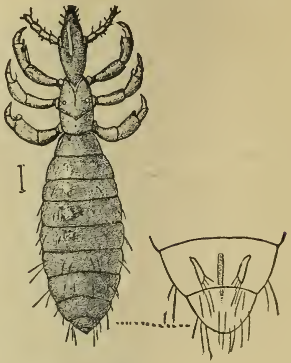

FIG 4.

Fig. 3. Egg of the long nosed ox louse. (Haematopinus vituli Linn.)

Fig 4. Long nosed ox louse (Haematopinus vituli) under surface of last segment of abdomen. From Osborn, United States Department of Agriculture.

BITING LICE OF CATTLE.

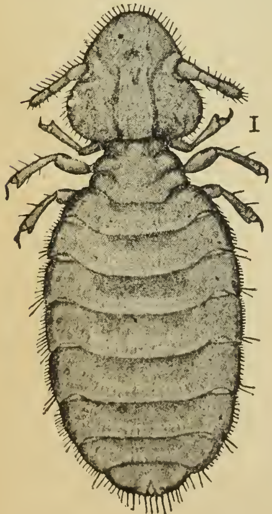

Fig. 5. Biting louse of cattle. (Trichodectes scalaris Nitzsch. From Osborn, U.S.Dep.of Ag. )

This parasite differs especially from the suctorial lice in the manner of obtaining food, being provided with strong mouth parts its food consists principally of the scales and secretions of the skin. The biting lice are easily distinguished from the suctorial lice by their color, the former being commonly spoken of as the red lice while the latter are called the blue lice. The red lice are also smaller and are the most common species found here. They may be found on any part of the body but especially on the back and sides. The biting lice do not take any food direct from the body but cause irritation by crawling over the skin.

*Treatment:* The same remedies are applicable to all species of cattle lice and are equally effective, except that the short nosed ox louse is more difficult to eradicate than the others Fumigation and dipping are two methods that are not practicable for the farmer with a few head of stock, and in any case the use of dips and other solutions during the winter months must be practiced with care on account of the danger of the stock contracting pneumonia and other diseases from being wet.

A remedy to be of general use must be cheap, easily prepared and easily applied. Chloro-Naptholeum, Zenoleum and Lincoln disinfectant have been tried in solutions varying from one-half per cent to one and one-half per cent. For practical use we have found that a one per cent solution of any of the above preparations when thoroughly applied by means of a sponge or spray pump will kill cattle lice. A second application will be needed to kill the lice that will hatch from the eggs, this should be used in about ten or twelve days after the first. The seed of stavesacre or larkspur may be steeped in water and this used as a wash and is considered as very effective against any form of external parasite. Kerosene emulsion has been tried with as good results as was obtained by using any of the other remedies.

### THE HOG LOUSE.

This parasite is probably the most generally distributed species of the louse affecting any of the domestic animals and is the only species found on hogs. It is never found on any other animal, consequently there is no necessity for any precaution so far as other animals are concerned. This parasite belongs to the group of suctorial lice and obtains its food by piercing the skin of the host animal. It is larger than any of the other species of suctorial lice, fully developed specimens measuring as much as one-fourth of an inch in length. On account of the thick covering of the body it is very difficult to kill by direct application of remedies, as dips, etc.

Since these parasites are so commonly present on hogs they are generally regarded as a necessary evil and their injury to the animal is entirely overlooked. The presence of large numbers of lice must necessarily interfere with the growth and development of the hog.

At different times during the last two years various solutions have been used both in the laboratory and on hogs in order to find some cheap and effective remedy to kill the lice. Some remedies were tried in order to test their value as insecticides that would have no value in practice. A number of coal tar dips were used and very little difference found in their efficiency. When used in very weak solutions as recommended by their manufacturers it required such a length of time to kill the lice as to make them useless for dipping purposes.

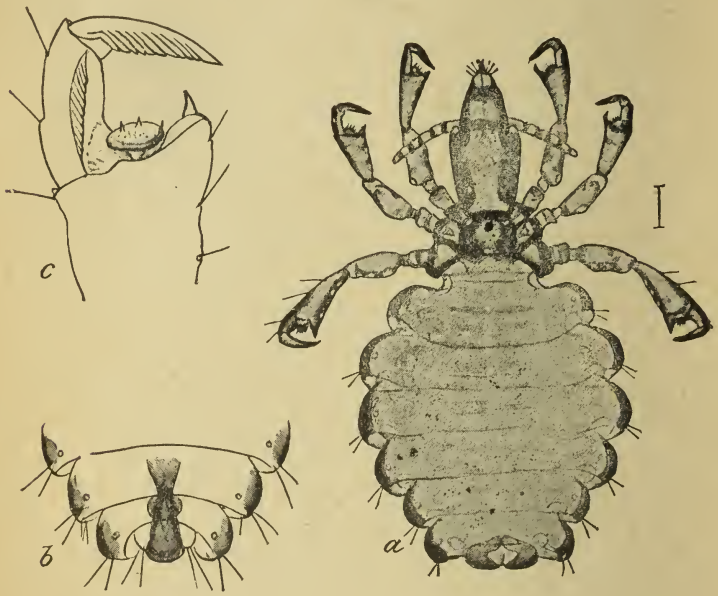

Fig. 6. Hog louse, (Haematopinus urius Nitzsch) a, female; b, posterior segments of male- c, leg showing disk of tibia. From Osborn, U. S. Department of Agriculture.

The results of all of the laboratory tests with Creolin, Zenoleum, Car-Sul and Lincoln disenfectant showed that not less than a two per cent solution can be relied on to kill the lice. By immersing the parasites in the above solutions the length of time an animal may be kept in the vat it was found that the lice were killed in from one to three hours after the use of the dip. To facilitate the work of applying dips a vat was constructed in which the college and station hogs are dipped as often as is necessary to keep them free from lice. The work is always accomplished without injuring or worrying the hogs to any extent.

## DIPPING VAT.

The location of the vat should be such that it will be as convenient as possible to the water and pens. By using movable panels of fence there will be very little difficulty in getting hogs to and from the vat. Wooden vats could be constructed for less money than the cost of the vat used in these experiments but they will not be as durable and consequently more expensive in the end. Galvanized iron, twenty-two gauge, and half inch gas pipe was used in constructing the vat. The entire cost was less than $25.00.

After using the vat for some time certain changes seemed desirable, especially changes in the dimensions and using a steep incline at the entrance to the vat instead of the perpendicular end as in the present vat. With these changes the cost for construction should not exceed $30.00. The frame of the vat must be rigid and nothing less than half-inch pipe should be used in its construction. By using couplings at the corners a very rigid and cheap frame can be made over which the iron is placed and the seams rivited and soldered. Before the vat is placed in the ground it should be filled with water and every leak stopped. Make an excavation sufficiently large for the vat and place a solid floor in the bottom on which the vat can rest. Braces should extend from the floor to the top of the vat to prevent bulging of the sides which will occur when the vat is filled and the ground becomes wet. Floor the inclines leading into and from the vat and nail cleats every six or eight inches on the one leading from the vat to assist the hog in climbing out. The dripping platform should be tight so as to conduct all of the drippings back into the vat and it should have cleats nailed on to prevent the hogs from slipping. Allow the vat to extend about four inches above the ground, protect it with fences and when not in use it should be kept covered to prevent the loss of dip by evaporation.

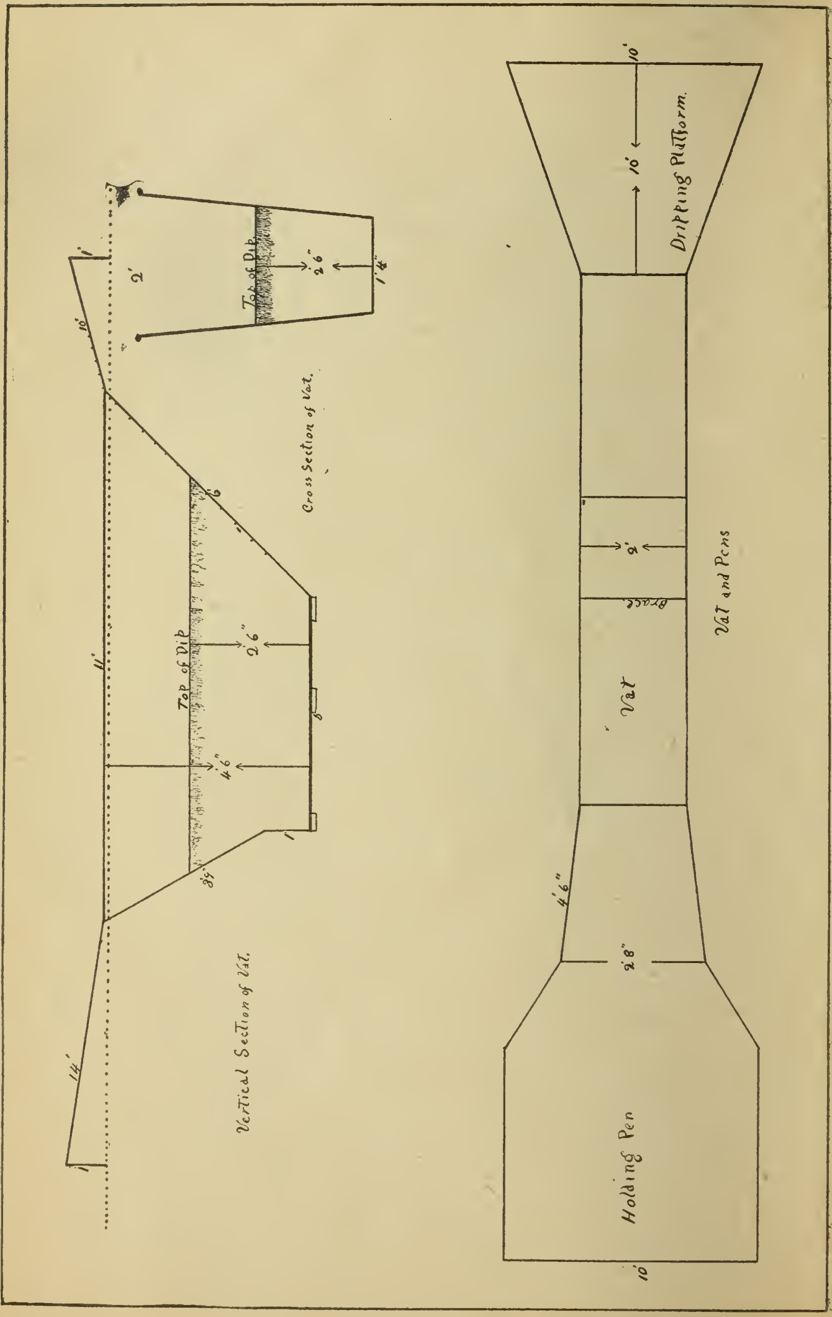

Fig. 7. General plan of dipping vat for hogs.

In dipping we have found it necessary to have some one place a board on the incline leading from the vat to hold the animal in the dip a sufficient length of time to allow the solution to kill the lice. If the hogs are not held in the vat they will not be exposed to the action of the dip a sufficient length of time for it to kill the lice. When the animal is stopped by the board we use a broom to splash the dip over the head and shoulders. The animals should be kept in the vat about twenty seconds, this is not long enough to worry the hogs and will be sufficiently long for the dip to kill the lice.

In the dipping experiments one per cent solutions of Zenoleum and Chloro-Naptholeum were used and were found to be of very little use as the greater number of the parasites were not killed. In later work two and two and one-half per cent solutions were used with better success as practically all of the lice were killed. Eggs taken from the animals after dipping were hatched in the laboratory showing that animals must be dipped two or three times to effectually rid them of lice. A comparison of the results of dipping in the two and two and one-half per cent solutions showed very little difference in their effectiveness. A few hogs showed a slight irritation of the eyes and the Chester Whites showed a redness of the skin for a few hours after dipping but in no case was the dip injurious.

Kerosene emulsion is a very effective remedy and has the advantage of being easily prepared and the material can be obtained from any groceryman. The emulsion used was made according to the following formula.

Hard soap, ½ pound.
Kerosene, (cheap grade) 2 gallons.
Water, 1 gallon.

Cut the soap into shavings and boil in the water until the soap is dissolved. Remove from the fire and add the kerosene, and churn or spray back until thoroughly emulsified. To the emulsion add seven gallons of water and use this for spraying. The cost of ten gallons of the emulsion will be less than forty cents. The emulsion can be made in large quantities and the vat used for dipping the hogs.

## SOUTHERN CATTLE TICK.

The relation of this parasite to Texas fever and the efforts made to prevent the spread of the disease by means of quarantine lines make it the most important parasite found on any of the domestic animals in Oklahoma. At one time very few believed that the tick was the means of spreading Texas fever but at the present time practically all such opposition has been overcome and the quarantine laws are more easily enforced than when stockmen had the idea that such restrictions were unnecessary.

On account of the relation of the tick to Texas fever efforts have been made to secure a dip that would be effective in ridding cattle of the ticks and that would not be injurious to the cattle. The Oklahoma Experiment Station conducted some experiments along this line which are reported in bulletin No. 39 to which those interested are referred. There are two reasons for desiring such a dip: first, it would enable any one to dip and ship cattle at any season of the year, and second, the advantage of being able to rid cattle of ticks on ranges and pastures where the infection is sufficient to interfere with the development of the animal. A practical and successful dip to be used in connection with shipping cattle north during the open season, must kill every tick and must not be injurious to the animal. The oils tried in the experiments referred to do not fully meet these conditions. Where dipping is practiced on the range and cattle after being dipped are turned back on the infected pasture it is not necessary that a dip to be practical and useful should kill every tick. The object of such work is to rid animals of the large number of ticks with which they are infected during the summer months. The dipping may be repeated as often as is necessary to keep the cattle practically free from ticks. The expense and trouble connected with such work will be more than repaid by the increased growth of the cattle.

Since experimental work has demonstrated that dipping is profitable a number of dips have been placed on the market. Probably none are better adapted for general use on range and farm cattle than the coal tar dips. They are cheap and can be used in from one to two per cent solutions without any injury whatever to the stock. Two per cent solution of Chloro-Naptholeum has been tried in vats by two persons near here, who dipped their cattle at intervals during the summer months. The effect of repeated dipping during the summer was to keep the cattle free from screw worms, lice. etc., as well as to kill the ticks.

### SCREW WORMS.

This pest is very common during the summer and fall and is seldom noticed before the first of June. Cattle are troubled more than any of the domestic animals as they are more apt to be wounded by brush, barb wire, etc., and in many cases the worms are found where ticks have been mashed or have fallen off, leaving a drop of blood which attracts the fly. The habit of the worm to burrow into sound flesh soon produces a considerable wound. The fly will deposit eggs in fresh wounds on an animal and they have occasionally given serious trouble to man. Specimens of the fly measure less than half an inch in length and are greenish in color with metallic reflections. The fly may be distinguished from other forms by the presence of three stripes on the thorax as shown in the figure.

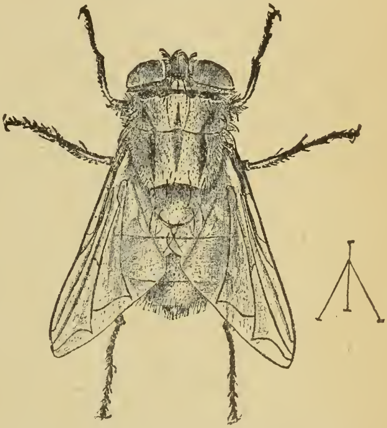

Fig. 8. Screw worm fly, (Compsomia macellaria) enlarged, after Francis. From Osborn, U. S. Dep. of Agriculture.

*Treatment:* Almost every stockman has a remedy for the screw worms. Some of these remedies are very effective while others are used in such a concentrated form as to be injurious to the animal. Frequently severe burns are seen where carbolic acid has been used too freely. Chloroform is one of the best remedies as it will penetrate every part of the wound and kills all worms that it comes in contact with. The disadvantage in its use is that it will not keep the flies from depositing eggs in the wound. Gasoline, carbolic acid in three per cent solution. creolin, zenoleum and chloro-naptholeum in five per cent solutions are all very effective in killing the worms. The principal difficulty is to get the remedy to all parts of the wound.

### HEN FLEA.

This pest was reported in the vicinity of Noble in Cleveland County, several parties complaining that they were losing poultry on account of the fleas. The parasite is very troublesome when once established, annoying people as well as fowls. In general appearance it resembles the common flea but is peculiar in its manner of locomotion. As a rule it does not hop but moves by crawling. Another peculiarity is that they attach themselves very firmly to the skin of the head and neck of the fowl so that it was necessary to remove them by means of forceps to get specimens for examination.

Creolin was used in a two per cent solution and was very effective, killing all of the parasites in a short time after the application of the remedy.

### HORN FLY.

This pest gets the popular name of horn fly from its habit of resting on the horns of cattle. They frequently collect on and around the base of the horns until these parts are covered. All of the flies by no means seek this region as they are frequently so plentiful as to cover the sides and back. There is much discussion in regard to the injury caused by this fly. After observing the effects of its presence there can be no doubt of the loss on account of the continual annoyance and worry of cattle when covered with the flies.

A description of the fly is unnecessary as it is of such general occurrence that every one is familiar with it. The fly does not occur in sufficient numbers to annoy cattle until about July, then they are so numerous as to be a pest until cool weather.

Several remedies have been tried in order to give some protection to cattle but only two have given results that would justify their use. One is a mixture of creolin, fish oil and kerosene of the cheaper grade.

Creolin, four parts.
Fish oil, two parts.
Kerosene, ninety-four parts.

When this preparation is thoroughly mixed and applied by means of a brush or mop to the back and sides it afforded considerable protection for several days. Another preparation used last year was prepared by the agricultural department of the station and was found to be very effective.

Pulverized resin, 2 parts.
Soap shavings, one part.
Water, one-half part.
Fish oil, one part.
Oil of tar, one part.
Kerosene, one part.
Water, three parts.

Place the resin, fish oil, soap and one-half part of water in a pan and boil until the resin and soap are dissolved, then add the remainder of the ingredients and boil for fifteen minutes. Apply lightly to the head, back and sides by means of a brush.

### BITING LOUSE OF HORSES, MULES, ETC.

This louse is very well known to stockmen and can usually be found on colts and horses in the early spring. They occur most abundantly on the neck, especially in the mane and around the base of the tail. Horses frequently rub the mane and tail in such a manner as to make them unsightly and if these parts are examined closely lice will usually be found. The lice are the color of the biting lice of cattle and any one not familiar with their slight differences would easily mistake one for the other but we have never found cattle lice on horses even when horses have been kept in the same barn or stalls that have been occupied by lousy cattle.

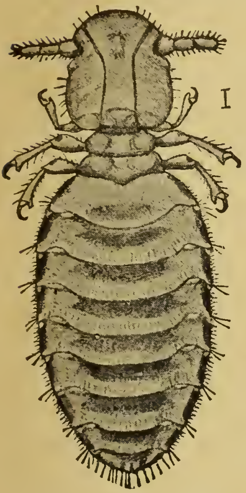
Fig. 9. Biting louse of the horse. (Trichodectes parumpilosus) From Osborn United States Department of Agriculture.

### THE SUCKING HORSE LOUSE.

This species of louse is as common here as the biting louse although it is commonly reported as being very scarce. As in the case of the other suctorial lice this one obtains its food by piercing the skin with its mouth parts and the irritation caused is produced in this way. The louse is darker in color than the preceding species and it is also smaller.

The same remedies may be used to rid horses of lice as are used against cattle. Usually the lice are not distributed over the body of the the horse making it comparatively easy to treat them.

### THE OX BOT FLY.

This fly is more commonly known in the west as the heel fly and it is the cause of much annoyance to cattle. When attacked by this

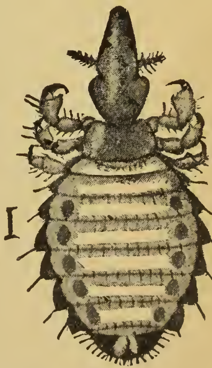
Fig. 10. Sucking louse of the horse. (Haematopinus asini) From Comstock.

fly cattle show extreme fear as they will run considerable distances in order to reach mud or water where they will remain for hours in order to protect themselves from the fly.

The "warbles" or lumps found on the backs of cattle during the late winter and early spring are caused by the larvae or grub of the fly. The eggs are deposited on the body and the larvae are taken into the mouth and pass by way of the oesophagus to the tissues along the back.

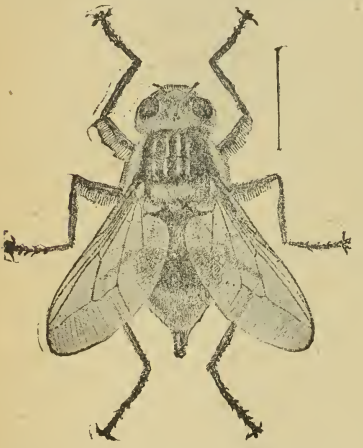

Fig. 11. The ox bot-fly (Hypoderma lineata) female, natural size indicated by side line. From Osborn, U. S. Dep. Ag.

The injury done by the fly is the annoyance they cause cattle and the damage to hides on account of the holes that are made when the grub escapes from the back. By examining cattle during February and March one can easily locate the larvae and a close inspection will show the opening in the skin through which the grub breathes and through which it will escape from the tissues.

The simplest method of destroying the "warbles" is to apply kerosene or other oils to the place as soon as the grub begins to develop. By means of a hypodermic syringe injections of chloroform, gasoline or weak solutions of carbolic acid may be used with good success.

### MANGE OF DOMESTIC ANIMALS.

Practically all animals of the farm may suffer from some form of mange. In some it is more common than in others, as it is very frequent in the sheep and dog, common in the horse and rare in cattle and hogs. The disease is usually classed as contagious and it may take the form of an epizootic. The cause of mange is a small mite that lives on or under the skin. There are many forms of skin diseases that may resemble mange in some respects but true mange does not exist unless the mange mites are present. In many cases these mites may be carried from one species of animal to another, differing in this respect from the lice.

The term mange is very incomplete unless the particular mite is known as there are three different forms of mange distinguishable, as sarcoptic, psoroptic and symbiotic, according to the particular group of mites present. The sarcoptes live in the skin and cause intense itching and irritation, the psoroptes live upon the surface of the skin and obtain their food by piercing the skin while the symbiotes live upon the skin of the extremites. Psoroptic mange is probably the most common form found on cattle, horses and sheep.

### SHEEP SCAB.

This is the only parasitic disease of sheep that is regarded by the stockman as very serious and most states and territories have laws governing the movement of infected animals. The disease is caused by a small mite that may be found under the crusts and scabs from the skin and it is easily spread in the flock by contact of animals or by pieces of scabs and wool that may be left by diseased animals on fence posts, brush, etc.

There are other diseases of the sheep that cause loss but none attract the attention or cause such vigilant measures to be adopted as scab. The loss of wool and flesh in the individual animal and the rapidity with which it may attack the entire flock makes it very important to adopt measures that will prevent the disease from spreading. If the disease is to be checked, the diseased animals must be dipped in some suitable preparation that will kill the mites. The vat used for dipping hogs may be used for this purpose and the same preparations of the coal tar dips may be used for the scab mite as recommended for lice. Such a vat is well adapted for general use for small animals. For large ranches a more extensive vat would be required.

A number of special dips can be obtained on the market but none are better than the tobacco and sulphur dip used by the New South Wales sanitary authorities:

Tobacco leaves, 1 pound.
Flowers of sulphur, 1 pound.
Water, 6 gallons.

Make an infusion of the tobacco by placing one pound of the leaves or manufactured tobacco in a gallon of water and allow to stand for twenty-four hours. On the evening before the dip is to be used bring the water near the boiling point then remove from the fire and allow to stand over night. Mix the sulphur in another gallon of water. When ready to dip strain the tobacco from the infusion, mix this with the sulphur water and add four gallons of water. For making large quantities of the dip the amounts given in the formula are increased but they must be used in the same proportion.

## CATTLE MANGE.

This disease is more commonly known in the west as Texas itch, but it is a true mange being caused by psoroptic mites which live on the suface of the skin. The disease is rarely seen in Oklahoma as only two cases have been reported. These came from the western part of Oklahoma and involved only a few cattle on small ranches.

Where the disease exists to any extent the only practical way to deal with it is to construct dipping vats and dip the cattle as recommended for the destruction of ticks.

## MANGE OF THE HORSE.

The horse may be infected with any of the three groups of mange parasites. With the exception of the symbiotic mange, which is usually located about the pastern joints, the disease is most commonly seen on the sides of the neck, base of the tail or on the inner sides of the limbs. The mite is so small as to be easily overlooked in making an examination. If the mites are present they may be seen by placing pieces of crusts and scabs on dark paper when the small lighter-colored mites may be seen.

With the exception of mange of the pastern joint the disease is very difficult to cure in the horse unless it is stopped in the early stages. Sulphur ointments and washes with tobacco infusions are effective remedies but usually several applications are necessary. Carbolated glycerine or vaseline containing ten per cent. of carbolic acid are good remedies as they soften the skin and at the same time kill the mites.

As a precaution against spreading the disease to healthy stock, harness, saddles, blankets, etc., that have been used on the diseased animal should not be allowed to come in contact with other stock.

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# Oklahoma Agricultural Experiment Station.

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## BULLETIN NO. 54.

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JUNE, 1902.

# THE IMPROVEMENT OF THE CASTOR PLANT.

W. R. SHAW.

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STILLWATER, OKLAHOMA.

# Oklahoma Agricultural and Mechanical College.

# Agricultural Experiment Station.

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# THE IMPROVEMENT OF THE CASTOR PLANT.

W. R. SHAW.

The castor plant is cultivated as a field crop, solely for the oil which is produced in the seeds, which are commonly called castor "beans". The percentage of this oil in the seeds varies, and the report is current, and supported by all the evidence, that the average percentage of oil in seed produced in Oklahoma is much less than the same average in seed produced in regions further north and further east. This difference in favor of the product of other districts may be partly ascribed to general lack of adaptation of the castor plant to Oklahoma conditions, but it is probably mostly, if not entirely, due to the lack of selection of varieties of the plant specially adapted to the production of a high grade of seed under Oklahoma conditions. The remedy, then, for those who are interested in promoting the culture of the castor plant, is to be sought in the introduction or production of new varieties or sorts of castor plants, which will yield a higher grade of seed, and in the improvement of the varieties already cultivated, by careful selection of the seed for planting.

In grading castor seed in the St. Louis market the weight of a struck bushel of "beans" forms the basis of the system. The grades are; "Prime", 41 lbs. or more per bushel, sound and sweet, and free from frosted seed; "No. 2", 40 lbs. or more per bushel, and sound and sweet; "Rejected", 38 lbs. or more per bushel; and "no grade", weighing less than 38 lbs. per bushel. We are informed by Mr. W. F. Chamberlain, inspector for the Merchants Exchange of St. Louis, that during a period of five years the seed produced in Illinois averaged 43 lbs., in Kansas 42 lbs., and in Oklahoma 41½ lbs. For the last season, owing to the drought, the average was lower in all these states.

The relative value of the different grades of seeds depends primarily on the relative percentage of oil in the seeds of the different grades. This percentage depends somewhat on the degree of maturity of the seeds, the completeness with which the seeds are filled out. But a most marked variation in the percentage of oil is found on comparison of the determinations of oil in the seeds of different varieties and sorts of castor plants. Samples of twenty sorts of castor seeds which were used in beginning a series of experiments showed, when the percentage of oil was determined by the Chemist, a range of variation from about 45 per cent to about 55 per cent. Samples of seeds of the same sorts grown in Oklahoma yielded, when tested in the same way, percentages of oil ranging from about 43 per cent to about 55 per cent. The average of the percentages was lower for the latter seeds than for those imported, as might be expected of the yield of unacclimated varieties of most cultivated plants. While the percentages of oil obtained from the imported and the home grown seeds of the same sorts did not correspond closely, most of the varieties which yielded more than 50 per cent from the purchased seed, yielded more than 50 per cent from the home grown seeds, and most of the varieties which fell below 50 per cent in the first test also fell below that per cent in the second test. This goes to strengthen the view that the amount of oil produced in any given castor seeds depends largely on the variety, sort, or strain of the plant or plants producing the seeds.

In the first of these tests the variety commonly grown in Oklahoma was represented by a sample of seed grown on the station farm, which yielded 46.33 per cent of oil. Plants grown from seeds taken from the same sack produced seeds of which a sample yielded 48.41 per cent of oil. A sample of the seed from another sort of castor plant grown in the same plat yielded 54.43 per cent of oil. It is hoped that, by selection of seeds based on tests of the percentage of oil as shown by chemical analysis, the station will be enabled to produce new sorts, or improvements of the old sorts, which will yield on the average a larger percentage of oil.

The second point which goes to determine the relative value of two sorts of castor seeds for planting purposes, is the amount of seeds which can be harvested from the plants of each sort. Other things being equal, the plant from which the greater amount of seeds can be profitably gathered is the better one. The different varieties and sorts of castor plants vary greatly in the amount of seed which they produce. Most of the numerous varieties raised in this country are grown for ornament, and some of these produce no seed in our climate. This is not because the climatic conditions are unfavorable for growth, for some of these plants produce the largest of stalks. The plants simply do not come to a fruiting maturity in a growing season as short as ours. Then there are some of the ornamental varieties which produce seed in small quantities, and others which produce it in large quantities In a test of the yields of a number of varieties of castor plants, those of the common sort produced much less than half as much seed by weight as the same number of plants of a number of other varieties. In this test the conditions were not uniform for all the varieties, but the difference in the yields seems to be greater than could be accounted for by the difference in the conditions. In each of the varieties which we have referred to as the ornamental varieties, there was also a very great difference in the amount of seed produced on the different plants. Some of the plants produced no seed at all, not even flowers, while others, growing under what would seem to be exactly the same conditions, produced large quantities of seed. The record of the yields of individual plants shows an enormous variation in the amount of seed produced by them. Unfortunately the records of this experiment, which was begun with another purpose in view, do not show the amount of variation in the seed production of the individual plants of the common castor plants grown under the same conditions. But we may safely say, from a general knowledge of plants, that this variation is considerable. And in general, the plant which ripens its first spike earliest, produces the largest quantity of seed in the season

There are some other points to be borne in mind, in considering the improvement of the castor plant. The merit of a plant depends not only on the quality and quantity of seed produced by it, but also on the cheapness and completeness with which the seed may be gathered. It is the natural habit of the varieties of castor plants with which we are familiar, to discharge the seeds from the pods soon after they are thoroughly ripe. And as the different pods on a spike do not ripen at the same time, the lower ones ripening earlier than the upper ones, it is necessary to gather the spikes before all the pods are thoroughly ripe, in order that seed may not be lost by being discharged from the ripest pods. There is a great difference in varieties in this respect. Although we have no systematically recorded information on the different varieties in regard to this point, observation has shown that the plants commonly cultivated ripen the pods of each spike more nearly at the same time than do some of the other sorts. But even if all of the pods on a spike ripen at practically the the same time, a difficulty of the same nature remains, because the different spikes on the plant mature in succession, and on different plants at different times. This necessitates repeated gathering of the spikes at frequent intervals. An ideal plant which some cultivators would seek, is one which would mature its spikes late in the season and, at about the same time on all plants, so that the harvest might be accomplished in a short time. The ideal of other planters is a plant which matures its first spike very early in the season and continues to mature spikes until the end of the season. so that each such plant produces in the course of the season a large amount of seed. Toward which of these ideals the castor plant may be most easily improved, is a question which further experience and experiment must answer.

Were it not for the fact that the natural opening of the pods and discharge of the seeds is made use of in shelling them, our first thought and endeavor would be to secure plants on which the pods would not open at all, or better, would open only after the action of frost on them. If in any way we could secure such plants, and at the same time provide some threshing device which would separate the seeds from the pods, the gathering of the crop would be cheapened and the seeds on large spikes would be given time to ripen more uniformly. The difficulties in the way of this solution of the problem are great, but the matter is worthy of some serious attention in connection with any series of experiments or studies on the plant.

What is wanted by those who are engaged in raising the castor plant is some method of improving varieties which will begin to show returns almost from the start. The greatest opportunities in this direction are to be sought in systematic selection of the seed for planting. This selection should be made from seed grown in the neighborhood where it is intended to continue the culture of the plant. In other words, the man who raises castor plants should raise his own seed, or get it from his neighbor who has selected it according to some approved plan, rather than buy it from unknown sources. One reason for this, is the fact that when a variety of a plant is properly cultivated in a particular region, the particular plants thus cultivated become, in time, specially adapted to that region, its climate and soil, and do better there than elsewhere, and do better in their adopted home than other plants of the same sort which may be introduced later. The plants after having lived for a number of generations under one set of conditions become adapted to those conditions, acclimated. The sort of castor plants which we have referred to as the one commonly cultivated in our territory, has this advantage over any other strains of the same sort which we might seek to introduce. They show it in a number of ways; by greater uniformity of stand, by higher percentage of germinating seeds, and perhaps by less variation in the amount of seed produced on the indivdual plants. But because they are acclimated is no reason why we should not seek further improvement of the variety. It is all the more desirable that we should endeavor to bring the variety in question up to the grade of the best varieties with a high percentage of oil in the seeds, and at the same time make it, if possible, productive of more seed.

A method ot seed selection has been suggested by Mr. R. D. Kirkpatrick, of Benton, Illinois, who has had long experience in raising this plant. His plan is to cut for seed only the first spikes to mature. These spikes are larger and have fewer unmatured seeds on them than those which are formed and ripen later. He cuts each of these first spikes near the middle, and saves for seed only the lower half, because the tops of all the spikes have some of the seed not well filled out. The lower halves of the spikes are thrown into sacks and hung up to dry. Treated in this way the pods pop open and discharge the seeds as they do when exposed to the sun. We venture to suggest that it would be well to have the sacks used for this purpose made of material which would give the drying pods good ventilation. The seeds are separated from the shells by running them through a fan. One advantage of this method of selecting the seed is, that the seeds thus obtained are all of high vitality, well developed and adapted to the production of vigorous plants. Then, too, seeds which mature early are supposed to produce plants with a tendency to ripen their first spikes early, and continued selection in this way for a number of successive years is expected to produce a strain of plants which will ripen their first spikes earlier than the stock from which selection was begun.

These very simple and practical directions for selecting castor seed may well be followed, and should give good results. A variation of this method which might be worth a trial, would consist in cutting the first spikes in two when they are yet only partly developed. The total sacrifice of the tops might be more than compensated for by increased vitality of the seeds on the lower halves of the spikes. Anyone disposed to give the matter a little more attention than is required to carry on selection by the method outlined above, may go further in the process and expect better results.

Two classes of seed may be selected, one for planting a special seed plot, and another for planting a crop. Both classes may be selected in the same way, but the first class with special attention, not only to the character of the spikes, but also to the character of the plants from which the spikes are taken. The object of this is to take advantage of the superiority of the few best individuals over the general run of the plants of a variety. The very best individual plants should, if possible, be picked out for this purpose. The points of superiority to be considered may be several or only one. They may include the quantity of seed produced and its quality, and also the character of the plant itself; as, for example, the height and mode of branching of the stalk. Short stalked plants might be given the preference as better adapted to stand high winds, and plants with short branches, or branches growing up at a sharp angle, might be chosen first, as better admitting of cultivation. Decide upon some type which will be an improvement and stick to it.

Choosing seed of plants on which the quantity and quality of the seed on the first spike show superiority, will be a comparatively easy matter. The number of well-filled or well-ripened pods on the spike may determine the choice. Choosing the plants which, in the course of the season, produce the most and best seed, is more difficult. It is accomplished at the Experiment Station by having a separate sack for the seed of each plant which is grown on the seed plat. The plants and sacks are numbered, and the seed of each plant is kept separate from all the rest until the close of the season, when it is a simple matter to weigh the seed from each plant separately and pick out the heaviest individual yields. And then the seed from each plant may be subjected to tests as to quality. The test used up to the present time is a chemical determination of the percentage of oil in samples of the seed. It is hoped to devise some simple and easy method of estimating sufficiently accurately for practical purposes the relative percentage of oil in small samples by a specific gravity test. But at present the experiments have not been carried far enough to warrant proposing such a test.

The gist of the whole matter of seed selection is, select the best and earliest seed of a crop for planting, and when practicable select this seed from the best plants of a stand.

When raising plants for seed selection in a separate plat, which is advisable for a number of reasons, the individual plants should be grown as nearly as possible under the same conditions. When this is done it is much easier to decide which plants are really the better ones. If grown in rows they should be spaced as uniformly as possible by planting thickly and thinning. If grown on "hills", several seed should be dropped in each hill, and when the plants are still young all but one or two should be removed from each hill.

To get good results from any work in breeding the castor plant in this territory one should give them thorough cultivation. It need be only deep enough to destroy all weeds and convert the crust which forms after a rain into a loose mulch. The plants need all the moisture they can get in the dry summers of this region, and the destruction of weeds and the stirring of the upper layer of the soil both serve to prevent the loss of water from the soil. The cultivation may well be continued through the season, as long as there are weeds to kill or a crust to break.

The most rapid improvement of the castor plants may be secured, as it is often done in the culture of other kinds of plants, by choosing for cultivation and selection varieties which exhibit a wide range of variation among the individuals. An increased range of variation may be induced in a variety by higher cultivation; as, improvement of the soil by the addition of manures, more thorough cultivation, and wider spacing of the plants. Increased variation may also be secured by the importation of seed from other regions; because individual plants react differently to changes of climate and soil. Lastly, increased range of variation is secured by the production of hybrids by cross pollination. Experiments in this method are now under way, and should in time yield greater returns than simple seed selection alone. But, as seed selection is necessary to secure results from hybridization, it is of highest importance, if any permanent direct benefit is to be derived from these experiments, that systematic seed selection should be practiced by all who take any interest in the culture of the castor plant. The benefits obtained by seed selection cannot be expected to endure unless the selection of the seed is continued.

Not the least of the benefits to be derived from closer study and practice of methods of selecting castor seeds, will be the effect, which it can hardly help having, of leading to more studied selection by all farmers of the seed of other crop plants; such, for example, as cotton. The time will be hastened when farmers will no more think of getting their cotton seed for planting from the last ginning of a season, than they would of going to slaughter pens to buy blooded stock for breeding purposes. Cotton has been the subject of much study and culture, and in all the older parts of the cotton belt much attention is given to the selection of seed. Some planters devote most of their attention to the raising of seed for planting, and it is much to be desired that those who take the greatest interest in the culture of the castor plant should improve their varieties or obtain better ones, and make a specialty of raising seed for their neighbors, rather than dispose of it on the market for oil mills.

# Oklahoma Agricultural Experiment Station,

STILLWATER, OKLAHOMA.

BULLETIN NO. 55, DECEMBER, 1902.

## BERMUDA GRASS.

### SUMMARY.

1. Of all the grasses tried on the station farm, Bermuda alone has shown the qualities which must be possessed by a pasture grass in Oklahoma.

2. While it is possible to eradicate Bermuda grass when well established, it should be started only on lawns or on land intended for permanent pasture and should be kept out of fields intended for cultivation. In ten years on the station farm, Bermuda grass has not spread to a troublesome extent into land where it was not wanted.

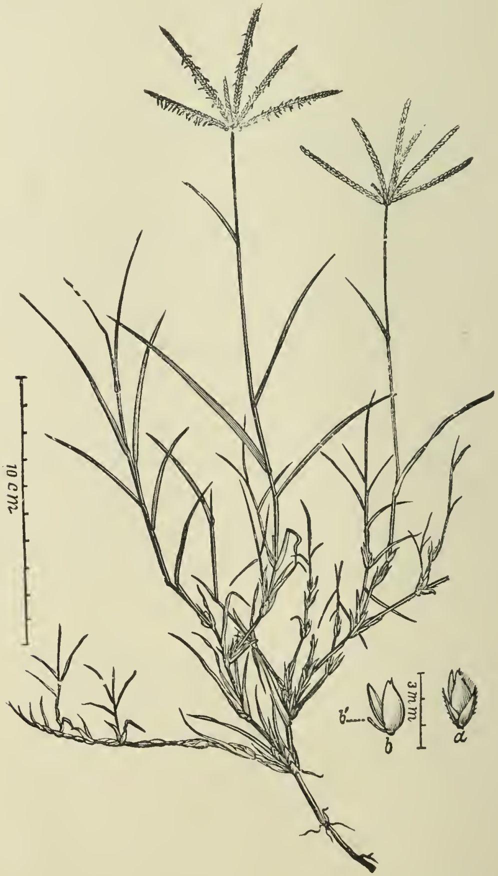
3. Bermuda grass should be given a trial on every Oklahoma farm where permanent pasture is wanted. A small start can be secured from seed which may be purchased of Southern seedsmen. This will furnish a supply of sod so that larger plantings may be made in succeeding years by covering pieces of roots in March and April, or even as late as August.

### INTRODUCTION.

The question asked most frequently by correspondents of the station during the past five years has been: "What grass have you found that will do well as lawn and permanent pasture?" Until about two years ago no satisfactory answer could be given and only suggestions as to grasses worth trying could be made. During the last two years, the answer has been more definite and Bermuda grass has been recommended as worthy of trial on all sorts of soils for pasture and lawn. Experiments made on the station farm and observations of trials made in many other localities have developed the fact that Bermuda grass will grow under a wide range of varying conditions in all parts of Oklahoma.

## DESCRIPTION.

Almost everyone in Oklahoma is acquainted with the appearance and habit of growth of buffalo grass. Bermuda grass resembles buffalo grass in many respects. It takes root at the joints and spreads rapidly from runners, but is larger, coarser, and greener than buffalo grass. The accompanying illustrations show the points of resemblance and difference.



Bermuda Grass, from Lamson-Scribner, United States Department of Agriculture.

Buffalo Grass, from Lamson-Scribner, United States Department of Agriculture.

In Oklahoma, the period of growth of Bermuda grass extends from about May 1st to November 15th, the most vigorous growth taking place during July, August, and September when even the native grasses are at a standstill. It furnishes a large amount of nutritious pasturage throughout the season and when a good stand is once secured, does not appear to be harmed by close grazing.

## STARTING BERMUDA GRASS.

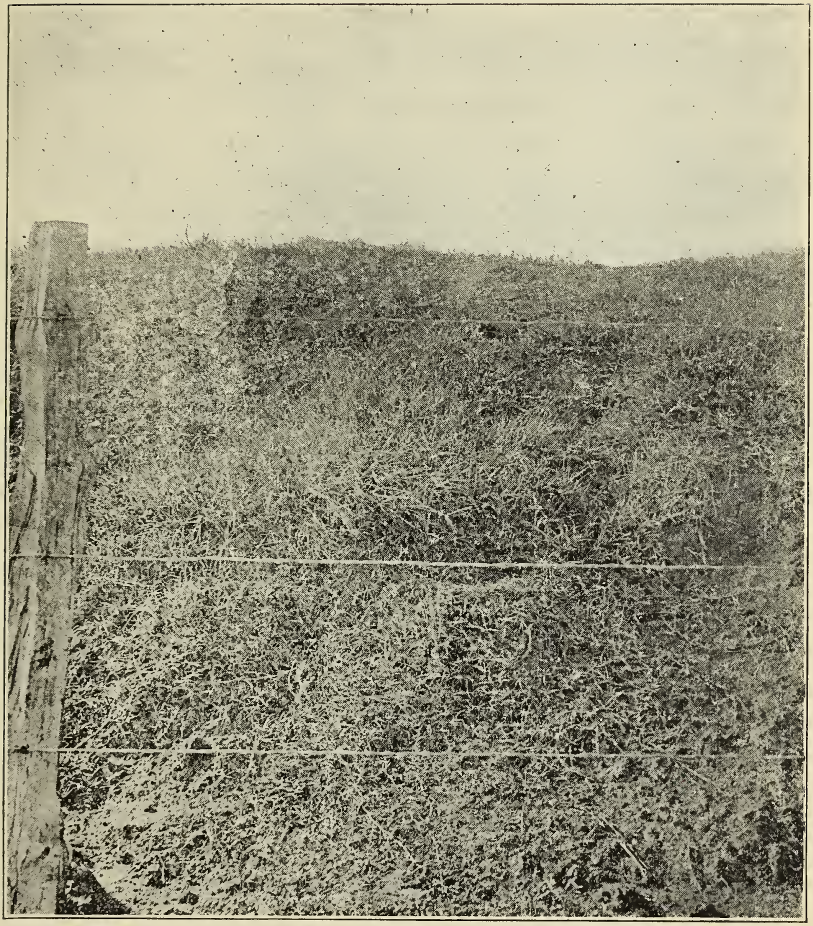
Bermuda grass is best propagated from pieces of roots, dropped in shallow furrows and covered with soil There is now no source of roots in Oklahoma from which a large supply may be procured and it is necessary at first to start a small patch from seed. Bermuda grass seed costs about one dollar per pound and one pound will seed a quarter of an acre. It should be sown during March or April in good, clean soil with a firm seed bed. The seed should be scattered over the surface, preferably during a light rain, and only lightly raked into the soil. When the plants first come up, they are very delicate and easily choked out by weeds or crab grass. Hand weeding or raking is often desirable and after the Bermuda grass has become thoroughly established, it will take care of itself. Seeds and possibly roots may be obtained from any Southern seedsman. The station has none for sale or for free distribution.

## ERADICATING BERMUDA GRASS.

Fortunately, the majority of Oklahoma farmers are not afraid of grass. They like to see it growing and they appreciate its value as feed for all classes of livestock. But there are some who fear anything that persists in growing and protest against Bermuda grass for this reason.

In so far as the station has been able to determine, Oklahoma grown Bermuda grass seed germinates but poorly and there is but small danger of the grass spreading from seed. With this danger so slight, Bermuda grass should be started only where it is to remain permanently and no attempt should be made to work it into a crop rotation. Its place is as a permanent pasture grass and for lawns.

Bermuda grass may be killed out by shallow plowing and harrowing during the fall and winter and by growing oats, or some other crop that completely covers the ground the following spring, to be followed by millet or cowpeas sown thickly as soon as the crop is removed. Where closely cropped, Bermuda grass is sometimes killed by hard freezes and but little trouble need be feared from its spreading where it is not wanted.



Bermuda Grass, Binding Soil of Pond Bank.

## FOR STOPPING WASHES.

The accompanying illustration shows one of the uses to which Bermuda grass may be put. It shows a portion of the bank of a pond in the pasture on the station farm. This pond is fenced and furnishes water for the barns and feed lots. It was cleaned out and enlarged during the fall and winter of 1901 and in March, 1902, pieces of Bermuda sod about six inches in diameter were stuck into the pond bank, about four feet apart. The bank in October, 1902, was nearly covered with a compact sod and with another season's growth, no ordinary amount of wave action would have any serious washing effect. Bermuda grass is being used to some extent in Oklahoma for holding railway embankments of loose soil and could be utilized profitably along many roadsides for the same purpose.

## EXPERIMENT STATION OPINIONS.

The following statements are taken from station publications and show a marked unanimity of opinion as to the great value of Bermuda grass for the purposes for which grass is most desired in Oklahoma, permanent pasture and stopping washing of the soil.

*Alabama.*—This grass will grow under the most flagrant neglect; while care and cultivation will bring out its characteristics to a marked degree and will repay the cultivator for all his expense and trouble. It is an excellent grass to prevent the washing of the land, for filling up gullies and preserving terraces. It makes one of the best lawns on account of its smooth and regular growth, and its power to withstand the heat of the sun. The Bermuda grass is not so difficult to eradicate from the field as most farmers seem to think. Close cultivation in cotton for two or three years, and thorough pulverization of the soil will destroy this plant.

*Arizona.*—This grass is used quite extensively in Arizona in the making of lawns, but from the creeping habit of its long, wiry stems, it becomes obnoxious in gardens and occasionally on the banks of ditches. In our climate, it seeds abundantly and there is danger that it may in time become much more harmful than it is at present.

*Arkansas.*—Bermuda grass is the best summer pasture grass we have for the sandy soils of south Arkansas and is one of the best hay grasses for all parts of the state except the northwestern part. It is not generally regarded with much favor but where it has established itself and is being utilized, it is regarded with great favor. On the barren soils, it does not succeed, but it succeeds on all other soils whether wet or dry. It makes hay of superior quality that is highly relished by livestock. When the value of Bermuda for hay, pasture, and a soil renovator is appreciated and the proper methods for cultivating and controlling it are understood, it will be a highly appreciated grass. Shade is fatal to the grass and by using the harrow, then oats, then cowpeas and cotton, the grass can be subdued and eradicated. To start the grass by seed is uncertain. The cheapest and best way to start it is to turn up a Bermuda sod and harrow the roots into piles, then chop them into short pieces with a hatchet and sow them on freshly broken soil and plow them in. The roots must not get dry while out of the ground.

*California.*—This grass has introduced itself in a bold and uninvited manner. Its perfect adaptability to the conditions is evidenced by the thrifty growth on all kinds of soil, including strong alkali, very dry and very wet, producing, more than any other grass (without care or planting), abundant feed during nine months of the year. The objections to this useful grass are mostly founded on the prejudice of the people, which renders them blind to their own interests. Many men are wearing out their lives in poverty, trying to grow fruit on land poorly adapted to fruit growing, but eminently adapted to Bermuda grass.

*Louisiana.*—For winter and early spring, Texas blue grass and the clovers seem to fulfill all the requirements, followed in summer by Bermuda and crab grass, the two best grasses we have. It was impossible during the wet summer to restrict the last two to the plots allotted to them, but together, they covered the wrole area of the (grass) garden, yielding several cuttings of hay for our work animals.

*Maryland.*—Bermuda grass was inferior to the growth in 1890, but still covered the ground well; this is of chief value as a pasture grass, and for holding hillsides and preventing gullies; it should not be tolerated near cultivated fields.

*Mississippi.*—This grass is the most valuable species we have in the South and is too well known to need any description. It succeeds best on rich bottom lands and on the black prairie soil, where it will yield two cuttings in a season, making two to four tons of hay per acre. This hay is of the very best quality, being especially valuable for horses and mules. When once established in a field, it is very difficult to eradicate and this is a decided objection to its general cultivation. The best method we have found for destroying it is to plow the land very shallow as early in the fall as possible. Plow again in November and sow oats. When the oat crop is removed, sow thickly with peas which will smother the few plants which may have survived the oats.

Results of feeding experiments with cows indicate that Bermuda and timothy hay have the same milk and butter producing values.

In order to ascertain the comparative values of Bermuda and timothy hay for feeding to work animals, the six mules belonging to the station were divided into two lots. Both lots received the same amount of corn daily, and were given all the hay they would eat, the feeding being continued two months. The results showed that there was practically no difference between the rations, (Bermuda hay and corn and timothy hay and corn.)

*Oregon.*—This is a valuable grass for the southern states and was tried on our plats last year. It started to grow very late and made but little growth till after the other grasses had made considerable advancement towards heading. During the drouth, it seemed to flourish best. It threw out branches three feet long, making a perfect sod over the plat, but was cut back to the roots by the frost in December.

## EXPERIENCE OF OKLAHOMA FARMERS.

For the purpose of ascertaining what was being done with Bermuda grass by farmers in Oklahoma, a letter of inquiry was sent to some of those to whom Bermuda grass had been recommended as worth trying. The final test of the value of a grass is its behavior under farm conditions and the station is under obligations to those who have furnished statements of their experience with Bermuda grass.

*Canadian County.*—(a) Bermuda grass that had good roots stood the cold weather of last winter all right. On the other hand, that which was not well-rooted killed out. I have inquired quite a little about it and it is generally admitted that it is the lawn grass for this climate.

(b) I bought some Bermuda grass seed last spring, and sowed it in my yard on May 8th. The grass came up and began to branch out a little when the dry weather set in and I thought that it was all dead. But to my surprise, when the September rains fell, it began to green-up and at this time is nice and green.

*Comanche County.*—I planted a small patch last spring, about May 15th. It was too late here, the hot sun destroyed it except little patches here and there. I think it will grow here if sown from March 15th to April 15th.

*Dewey County.*—One of my neighbors set some Bermuda grass stems six feet apart on July 8th, and it grew and has already formed a solid sod. I regard it as the best grass I have seen for this country. The above roots were set in pure sand, where the soil had all been removed with scrapers for the basement to a house.

*Garfield County.*—There is a small patch of Bermuda grass near here and it looks fine. I expect to put out some in the spring as I believe it to be the grass that we need in this country. We are in great need of some grass that will furnish pasture during the dry season.

*Grant County.*—We tried Bermuda grass last spring on a small scale, found it to be a success, and intend seeding more of it.

*Kay County.*—(a) I have concluded that Bermuda grass is the best lawn and pasture grass where it is necessary to stand drouth. Some object to planting it among trees, others say that if left to seed, it blows into the gardens and is hard to get out after it is started.

(b) I have tried Bermuda grass and have found it satisfactory in every respect. I shall sow ten acres of the grass in the spring as I think that it is the best pasture and lawn grass there is for this country.

(c) I got eight pounds of Bermuda grass seed last spring; sowed seven pounds of it in my pasture, the soil of which is very sandy. It did not come up very well but I think there is enough for a stand. It was bothered some by crab grass but as far as I can see, will do well. I gave five of my neighbors a portion of the remainder for lawn. Three out of the five lawns have grown well, two were taken entirely by crab grass. I also sowed one-eighth acre of lawn which came well and is fine. In all I am well pleased with Bermuda grass up to this time.

*Kingfisher County.*—(a) I planted some Bermuda grass seed near the house for lawn and am well pleased with the showing it made. It grew well all summer and though other grasses were killed by the dry weather in August, the Bermuda suffered very little. On the south side of the Cimarron river, two miles west of Dover, is a piece of Bermuda grass, probably several acres, that has done well this summer.

(b) Last spring I sowed English blue grass, orchard grass, and Bermuda grass. That which I mixed and sowed among the black jacks died out. But the same sowed on heavy land along the creek is growing. I sowed Bermuda grass around my house on ground that was packed, just raked in the seed and it did well. Shall sow only Bermuda heerafter.

*Logan County.*—My neighbor has a fine stand of Bermuda grass in his yard and along his hedge rows. He sowed the seed about sixteen months ago and now has a fine set and has commenced transplanting sod. I got a few sods and set them and they never wilted. We will plant three acres in the spring.

*Pawnee County.*—(a) I have used Bermuda grass for lawns since 1893 and consider it the only grass for this climate for that purpose. Blue grass for Kentucky but Bermuda for Oklahoma!

(b) I sowed Bermuda grass seed the last of April during a rain on stony land without plowing and I now have a fine sod and a pretty grass which has withstood the dry weather better than any other grass that I have seen.

*Woods County.*—(a) Bermuda grass is the best grass I know of for lawn or pasture. It stands drouth better than our native grass and spreads faster. The only thing against it that I know of is that it winter kills in badly exposed places.

(b) On April 10, 1902, I sowed two and one-half pounds of Bermuda grass seed, part for lawn and part for pasture; met with satisfactory results, have compact sod. On April 21, I planted a quarter of an acre of roots. On account of the indifferent manner in which they were covered, I lost the greater portion of them. Those that lived made a remarkable growth, making an almost compact sod. Soil is sandy, native grass is mostly bunch grass. I believe that Bermuda is certainly the lawn and pasture grass for our soil.

JOHN FIELDS.

Oklahoma Agricultural Experiment Station,

STILLWATER, OKLAHOMA.

BULLETIN NO. 56, DECEMBER, 1902.

# GARDEN VEGETABLES.

## INTRODUCTION.

A good garden will supply more food for the farmer's table than five times the same area planted to any of the ordinary farm crops. A half-acre of good land carefully planted to garden and well cultivated will produce an abundant supply of fresh vegetables for a family of five persons, from the time the first early radishes are ready for use till the frost kills the tomato vines in the fall. The question of quality of the vegetables should be considered before their productiveness. There is plenty of room for a garden on any farm and its location should be considered before that of any of the farm crops.

The garden should be located near the house and planted in long rows so that it can be cultivated with a horse. This will cause the rows of vegetables to be placed farther apart than is necessary for the good of the plants but much time and labor will be saved thereby. The common corn cultivators will do good work in the garden and will save a great deal of hard work with the hoe. Most of the varieties of vegetables that do not grow well in this climate fail on account of dry weather. Careful, constant, shallow, level cultivation is the best method that can be followed to retain the water in the soil and is absolutely necessary for the growing of vegetables. For most garden crops the land should be plowed in the fall and prepared for the seeding in the spring by a shallow cultivation and harrowing.

In the following pages a few of the garden vegetables are discussed. These discussions treat of the methods of planting and cultivating and of the different varieties tested and found to be valuable in Oklahoma. Variety tests and experiments in planting and cultivating have been made with all of these vegetables and the results of all this work are summed up in the discussions.

## TOMATOES.

The tomato is the most important of the vegetables grown in farm gardens. The season extends over most of the summer and early fall, and the canned and preserved fruits are to be had all the year round. The plants are easily grown and with a fair amount of care bear well on almost any kind of soil.

Although the tomato was introduced into vegetable gardens only a few years ago there are now varieties to fill every need that can be filled by that kind of vegetable. There are a few varieties that are widely grown and seem to be able to adapt themselves to the local conditions of soil and climate; among these may be mentioned Trophy, Perfection, Beauty, Ponderosa, Ignotum, Atlantic Prize, Favorite, Dwarf Aristocrat, and Dwarf Champion. There is a strong tendency to develop local varieties and in localities where large quantities are grown for the market, varieties are developed that are specially adapted to that section and to the uses to which they are applied. These local varieties frequently have no real or distinct name. It is usually best to trust to the seedsman for seed for the home garden and stick to the varieties that are found to do best. Seed may be saved if the crop is much better than the average but the seed should be saved from the best plants rather than from the best fruit selected indiscriminately.

The yellow-fruited varieties have fallen into disfavor and are usually grown only in small gardens. The yellow tomatoes as a class are softer and more juicy than red-fruited varieties and do not stand handling and shipping as well. The quality of the yellow varieties is hardly as good as that of the red tomatoes and with no distinctive merits in their favor, the discrimination against their color is constantly forcing them out of cultivation. The Golden Sunrise is a good yellow tomato with a reddish blush when ripe. The Golden Dwarf Champion is a very light yellow tomato. The fruit is very soft and cracks badly. The Yellow Plum is a very good tomato of its type but is of value only for preserves and similar uses. There is little distinction made between the red and purple varieties. To this class belong nearly all the varieties that are grown in the home gardens and the commercial plantings.

The size of the fruit of the different varieties varies from the little Cherry tomato to that of the large Ponderosa. The Cherry tomato is seldom as much as an inch in diameter and specimens of the Ponderosa frequently weigh a pound. The small fruited tomatoes are of little value except for preserves and butters and similar uses. The larger tomatoes vary in form from round like the Early Minnesota to the flat oval ill-shaped Atlantic Prize and the thick, smooth Trophy. The round form is most common in the small to medium sized early varieties and the better formed and smoother fruits are most common in the mid-season and late varieties. The medium and large fruits are usually preferred to the extra large fruits. The extra large fruits are more frequently rough and badly formed. The best form is an oval and thick from stem to blossom end. The surface should be smooth and free from folds and wrinkles.

The firmness of the fruit has much to do with its value for shipping and the cannery. The Ponderosa and Honor Bright are good examples of firm fleshed varieties and will stand shipping almost as well as apples and better than peaches. If the matured fruit is taken from the vines when the first light frost comes and laid on shelves in a dark cool room they will keep and ripen as late as Christmas. The greater the amount of solid flesh in proportion to the amount of seeds and pulp the better the tomato is for all purposes. Most of the good varieties range very close together in this characteristic and comparing the varieties of recent introduction to the old varieties it will be seen that there is constant improvement being made in this direction.

The length of the productive season is a point to be considered in the selection of varieties for the home garden. The aim should be to have a supply of good fruit during as much of the summer as possible. This can be done with less expense by planting a variety that produces fruit during a long period than by planting two or three times. The varieties that were planted on the experiment station farm last summer varied in length of productive season from 27 to 76 days. Most of the varieties continued to produce fruit until late in the fall but in most cases it was so small and in such small quantities that it was not worth picking. The length of productive season is here considered to be the time during which profitable pickings of marketable fruit were made.

Tomato seed should be planted about the first of March in hot beds or in small boxes that can be set near the stove in the house. The seed should be planted about one-half or one inch deep in moist rich soil. The seed may be planted quite thickly if the plants are to be taken up and transplanted as soon as large enough. The soil should be kept moist but not wet and at an even temperature. Too much water and heat will cause the plants to damp-off at the top of the ground. The young plants must not be allowed to stand too thickly or they will become drawn, that is, tall slender and weak and will not stand transplanting well. If the plants come up very thickly they should be thinned out or transplanted. If the small plants are transplanted to the field they will come into bearing late and much value of the crop will be lost.

Transplanting destroys many of the roots and unless good care is taken of the plants after transplanting, they will be checked in their growth and tomato plants that are checked or stunted while young will never entirely recover. If the seed is planted in the hot bed where there is plenty of room the plants should be thinned to three or four inches apart in the row. This will give the plants room to grow and become good, strong, stocky plants. The short, stocky plants will always stand transplanting better than those that are long and slender. The thinning should be done early so the plants will get started right. If the supply of plants is not large enough to admit of thinning, the plants taken out may be set in a cold frame or in boxes where they can be kept out of reach of frost. The plants that are reset may be set in a bed of soil or in pots of soil. The last method is the best as the plants can then be set in the field and not suffer the slightest check. If regular plant pots are not at hand, boxes or pots may be made of card board or paper. Tin cans do very well if the side is split so the soil can be easily removed when the plants are set in the field. Plants that are grown in individual pots or boxes can be transplanted to the field without being checked the slightest in their growth. The plants should be pulled from the bed and set in pots when they are three or four inches high, and may be grown there until they are ten or twelve inches high or until all danger of frost is passed.

To remove the plants from the original seed bed the soil should be thoroughly wet and then several plants taken up in a bunch and set in water. The plants can then be separated with little injury to the roots. Set the plants a little deeper in the field than they stood in the bed. Press the soil well around the roots and be sure that there are no open spaces in the soil near the plant. Water the plants good after they are set and prepare some kind of a shade for each plant for the next three or four days. A piece of shingle or board stood on the south side of the plant will do very well. If nothing better is at hand a piece of paper may be placed over the plant and held in place by soil laid on the edge of the paper. The plants may be protected from late frosts after they are set in the field by bending them down and covering them with soil.

If the cultivation is to be done with a horse cultivator the plants should be set in rows about four feet apart and from two to four feet apart in the row. The dwarf or tree tomatoes may be planted much closer than the vine varieties. If hand cultivation is to be given the plants may be set in rows two or three feet apart and two feet apart in the row. Crowding the plants will not reduce the total weight of fruit per acre as much as it will reduce the size and quality of the fruit, but for the home garden the plants should be given plenty of room so the best of fruit may be gathered.

The tomato does well on almost any kind of good soil but does best on a rich sandy loam. Heavy clay soil will grow good tomatoes if well cultivated but the crop will not be as early as if planted on a sandy soil.

Bottom land is usually best because it is richer and will hold more water than an upland soil.

There is but very little land in Oklahoma that is as rich as it should be for tomato growing. The best form of fertilizer for most of this land in preparing it for a tomato crop or for any other garden crop is well rotted barnyard manure. The manure should be applied in the fall before the land is set to tomatoes. If well-rotted manure is not to be had the fresh will do better than none, but the fresh manure should be applied about one year ahead and another crop grown on the land before it is set to tomatoes. Fall plowing usually gives the best results if the plow is run deep and the soil is well pulverized. The fall dressing of manure should be applied to the land before the plowing is done. A good harrowing in the spring with a straight toothed harrow will put the land in good condition for the plants unless the soil has packed very badly and then a surface cultivation with a light cultivator or disk will be all that is necessary.

A combination of cultivation with horse power and by hand is best and cheapest. A good horse cultivator will work the surface soil better than can be done with a hoe but the hoe should follow the cultivator and clean out all the weeds that have been missed and work the soil close about the plants. Cultivation should begin when the plants are set and continue until the growth of vines prevents the work. Tomato plants require a large amount of moisture and the very best cultivation should be given to retain the water that is in the soil. The large side roots do not run deep in the soil and thus necessitate shallow, level cultivation.

Pruning the vines to one or two stems and the training to a stake or trellis will slightly increase the size and quality of the fruit but will reduce the quantity. The season of ripening may also be made a little earlier but all the benefits derived from pruning and training will not pay for the time and trellis material used. Wet weather will sometimes cause the fruit to rot where the vines lie on the ground but the loss from this source is small and the amount saved by trellising will seldom pay for the material used.

The accompanying table is prepared from the record of the 1902 crop. Most of the varieties have been grown here before and the results are practically the same. The seed for the crop here reported was planted in the hot bed March 8, and the plants set in the field direct from the original seed bed on April 17 and 18. Twenty plants of each variety were set. The plants were set four feet apart in rows four feet apart. They were given clean shallow cultivation as long as a horse and a five shovel plow could go between the rows and then the weeds and grass were kept out with the hoe the remainder of the season. The table shows the date of first ripe fruit, the average weight in ounces of good fruit borne by each plant, the average weight in ounces of each tomato, the percent of fruits diseased, injured by insects or other causes that made the fruit unfit for market, percent of solid flesh in the fruit, and the length of the productive season.

TABLE I.

| NAME | First Ripe | Average Total Weight of Fruit Per Plant | Average Weight of Fruits | Per Cent of Fruits Rotten | Per Cent of Solid Flesh | Length of Productive Season |
|---|---|---|---|---|---|---|
| Acme | July 3 | 48.8 | 1.6 | 18.0 | 70.0 | 56 Days |
| Atlantic Prize | June 28 | 88.6 | 2.6 | 11.2 | 82.0 | 70 ,, |
| Beauty | July 16 | 41.1 | 2.3 | 23.5 | 71.4 | 51 ,, |
| Best of All | ,, 19 | 11.3 | 1.9 | 37.3 | .......... | 42 ,, |
| Buckeye State | ,, 19 | 9.0 | 2.0 | 32.7 | .......... | 47 ,, |
| Climax | ,, 5 | 31.8 | 1.7 | 38.3 | 69.1 | 51 ,, |
| Combination | ,, 5 | 29.7 | 1.9 | 17.8 | 75.0 | 45 ,, |
| Crimson Cushion | ,, 14 | 31.5 | 2.9 | 16.9 | 87.5 | 56 ,, |
| Dwarf Aristocrat | June 28 | 60.0 | 1.7 | 13.5 | 77.9 | 67 ,, |
| Early Minnesota | ,, 24 | 124.0 | 1.1 | 11.6 | 77.0 | 76 ,, |
| Early Purple Advance | July 16 | 9.5 | 2.0 | 31.6 | .......... | 27 ,, |
| Early Ruby | June 21 | 115.0 | 2.5 | 20.8 | 83.3 | 76 ,, |
| Enormous | July 5 | 5.9 | 2.0 | 32.7 | .......... | 47 ,, |
| Essex Early Hybrid | ,, 7 | 38.1 | 1.9 | 27.1 | 76.9 | 63 ,, |
| Excelsior Purple | ,, 9 | 6.0 | 1.5 | 21.0 | .......... | 34 ,, |
| Favorite | ,, 9 | 22.5 | 1.5 | 12.1 | 70.9 | 54 ,, |
| Fifty Days Earliest | June 24 | 106.8 | 1.3 | 12.6 | 75.0 | 76 ,, |
| Fordhook Fancy | ,, 28 | 35.7 | 1.7 | 12.6 | 80.0 | 70 ,, |
| Fordhook First | July 5 | 44.0 | 1.7 | 16.7 | 72.7 | 64 ,, |
| Freedom | June 28 | 52.0 | 1.0 | 19.8 | 80.0 | 72 ,, |
| Golden Dwarf Champion | July 1 | 41.5 | 1.4 | 14.4 | 80.9 | 70 ,, |
| Golden Sunrise | ,, 5 | 16.8 | 2.6 | 38.5 | 75.7 | 49 ,, |
| Honor Bright | ,, 7 | 21.3 | 1.9 | 26.9 | .......... | 63 ,, |
| Ignotum | ,, 12 | 24.6 | 2.5 | 30.1 | .......... | 58 ,, |
| Imperial | ,, 3 | 35.9 | 2.3 | 30.4 | 72.7 | 59 ,, |
| Kansas Standard | ,, 7 | 40.8 | 2.0 | 19.6 | 80.6 | 61 ,, |
| Large Early | ,, 23 | 12.6 | 2.8 | 15.3 | .......... | 29 ,, |
| Lorillard | ,, 7 | 33.5 | 1.8 | 18.5 | 72.7 | 57 ,, |
| Magnus | ,, 9 | 11.6 | 1.7 | 43.5 | .......... | 45 ,, |
| Matchless | ,, 28 | 9.2 | 1.8 | 30.2 | .......... | 42 ,, |
| Mayflower | ,, 9 | 27.4 | 2.0 | 21.0 | 80.9 | 38 ,, |
| Peach | ,, 5 | 77.0 | .7 | 22.2 | 78.9 | 65 ,, |
| Perfection | ,, 3 | 37.2 | 1.8 | 22.3 | 75.0 | 63 ,, |
| Ponderosa | ,, 19 | 13.3 | 3.7 | 32.5 | .......... | 44 ,, |
| Quarter Century | ,, 3 | 35.7 | 2.1 | 30.5 | 79.4 | 66 ,, |
| Quick Sure | ,, 17 | 94.6 | 2.0 | 38.0 | 84.6 | 70 ,, |
| Royal Red | ,, 7 | 23.8 | 2.4 | 25.6 | 72.2 | 54 ,, |
| Spark's Earliana | ,, 3 | 71.1 | 2.2 | 21.1 | 81.1 | 61 ,, |
| Success | ,, 16 | 17.0 | 2.1 | 29.0 | .......... | 47 ,, |
| Table Queen | ,, 3 | 35.5 | 1.7 | 42.2 | 81.2 | 65 ,, |
| The Stone | ,, 16 | 10.4 | 1.8 | 46.3 | .......... | 42 ,, |
| Trophy | ,, 3 | 42.0 | 2.0 | 20.5 | 72.9 | 63 ,, |
| Trucker's Favorite | ,, 9 | 3.5 | 1.9 | 47.0 | .......... | 42 ,, |
| Yellow Plum | ,, 3 | 81.4 | .4 | 14.6 | 84.6 | 63 ,, |

The following varieties have given the best results in three years tests and are all that merit description here.

Atlantic Prize; fruit large, oval, irregular, cracks badly, light red; vine small many branches, prostrate, leaf medium size.

Beauty; fruit medium to large, oval, thick, firm, dark red or purple; vine large, many branches, prostrate, leaf medium size.

Dwarf Aristocrat; fruit medium size, round or oval, smooth, firm, bright red; vine small, stout, tree form, leaf large.

Early Minnesota; fruit small, round, smooth, borne in clusters, bright red; vine small to medium size, many branches, prostrate, leaf small.

Early Ruby; fruit large, oval, slightly irregular, medium firm, bright red; vine medium size, many branches, semi-erect, leaf medium size.

Favorite; fruit medium size, round or oval, thick, smooth, firm, bright red; vine large, long, slender many branches, prostrate, leaf medium size.

Ignotum; fruit large, round or oval, thick, smooth, bright red; vine large, many branches, prostrate, leaf large.

Kansas Standard; fruit large, round, smooth, thick, firm, bright red; vine small, stout, tree form, leaf very large.

Perfection; fruit medium to large, oval, smooth, dark red; vine large, many branches, prostrate, leaf medium size.

Ponderosa; fruit very large, oval, thick, smooth, firm, dark red or purple; vine medium size, many branches, prostrate, leaf medium size.

The Stone; fruit medium size, round, thick, smooth, firm, bright red; vine large, many branches, prostrate, leaf small.

Trophy; fruit large, round or oval, medium thick, smooth, firm, dark red or purple; vine medium size, long slender, many branches, prostrate, leaf medium size.

## EGG PLANT.

The egg plant is seldom found in the farm gardens of Oklahoma and most of the attempts at growing this plant in this country have resulted in partial or entire failure. It can not be relied upon like some of the more hardy crops but with fair care and attention it is a plant that is worthy a place in every garden. The plants are very tender to frost and suffer from the hot weather. They should be started early and handled the same as tomato plants until they are set in the field. Care must be taken to keep the plants in good growing condition from the time they appear above ground till they begin to fruit. If the growth is checked while they are young they will never entirely recover.

The plants should be set about two feet apart in the row in rows three or four feet apart. Shallow, level cultivation gives the best results and this must be frequent enough to keep down the weeds and continue throughout the summer. Deep cultivation will do direct harm unless the ground is full of moisture.

There are but a few varieties of this plant in cultivation and only three varieties have been found that have proven to be worthy of cultivation in Oklahoma. Those three varieties are Fordhook Improved Spineless, New York Large Purple, and White Pearl. The first two varieties produce large purple fruits and the other creamy white or light green. It requires about 100 days for either of these varieties to grow and mature fruit. The White Pearl seems to be the most productive. The quality of all the varieties is about the same. For market the purple fruited varieties are grown and for home use the white is preferred.

## ONIONS.

Onions are more easily grown than most any other garden crop. The different varieties vary some in their adaptability and in their keeping qualities. In all the variety tests that have been carried on at the experiment station there has not been a variety found that is not worth cultivation. Some varieties are much better than others and should be planted in preference to others. The red, yellow and brown onions are better for market than the white but for early onions some of the white varieties are best. The large onions are usually sweeter and more mild in flavor than the small onions; and of the large, the yellow and brown are better flavored than the red. In selecting varieties for home use it is best to choose those that produce large bulbs and are good keepers. These characteristics should be considered first and then the relative yield per acre. The yield per acre can be influenced much more easily than the flavor and keeping quality of the bulbs.

The seed is cheap and for starting the general crop, is better than the sets. The sets will produce marketable onions earlier in the spring but this is about the only purpose for which they are better than the seed. The seed is cheaper, easily planted and in every way as easily cultivated as the sets.

The land for the onion bed should be plowed in the fall or early winter and given a shallow surface cultivation just before planting the seed in the spring. The seed should be drilled in rows about 18 inches apart. The soil should be pressed down well on the seed to insure an even stand of plants. The planting should be done by the middle of March so that the plants can complete their growth in the early part of the summer. Onion seed deteriorates very rapidly with age and only the seed of the previous season can be depended upon. The seed germinates very slowly and if the soil is dry germination may be hastened by soaking the seed for a day or two before planting.

The land should be cultivated as soon as the young plants appear above ground. The first cultivation can be done with the garden rake or some light tool that will stir the surface soil. As soon as the plants are large enough to be pulled by the tops they should be thinned to three or four inches apart in the row. This work is necessary and the earlier it is done the better. The land must be well cultivated throughout the growing season and kept free from weeds and grass. Shallow, level cultivation is the best and any work that tends to ridge the rows should be avoided.

Starting the plants in the hotbed and then transplanting them to the open ground has been tried and has regularly given a poor crop. The soil is usually too dry in the early spring for this method to succeed.

The bulbs should be left in the ground until the tops are dead. They should then be taken up and stored in a dry cool place until marketed or used. The dead tops may be cut off when the bulbs are pulled or they may be left on until the onions are marketed. Moisture will cause the onions to rot and a high temperature will cause them to sprout.

The best way to store them is to pile them on the floor or on shelves and then cover with straw or some similar material that will not prevent them from getting fresh air. They should not be piled more than twelve or eighteen inches deep. Freezing will damage them very little if they are kept frozen until spring and not allowed to freeze and thaw repeatedly through the winter.

The table here given is compiled from the record of the 1902 crop. The yield per acre is calculated from small plats and shows only approximately what might be expected from larger areas. The onions were gathered as soon as the tops were dead. The tops were cut off and the onions placed in small boxes on the floor of the hay mow in the barn. This was not a good place for them for they were just beneath the roof and the temperature was too high. The onions were counted on November 4th and all that were sprouted or rotten were classed as unsound and the percent sound was calculated from these figures. With better conditions of storage the poor keepers would no doubt have made a better showing and the good keepers would have had very little loss.

The best six varieties for general planting are Australian Brown, Giant Red Rocca, Michigan or Ohio Globe, Pink Prizetaker, Prizetaker, and Southport Red Globe. These are all good onions and are the best yielders and keepers of any varieties that have ever been grown on the experiment station farm. Giant Rocca of Naples, Giant Yellow Rocca, and Red Victoria are very productive varieties but are very poor keepers.

TABLE II.

| NAME | Date Gathered | Yield Per Acre Bu. | Percent Sound November 4 | Color |
|---|---|---|---|---|
| Australian Brown | July 21 | 242 | 83 | Brown |
| Australian Yellow Globe | " 28 | 242 | 35 | Yellow |
| El Paso | Aug. 1 | 181 | 26 | White |
| Extra Early Barletta | July 15 | 161 | 27 | White |
| Extra Early Queen | " 15 | 193 | 32 | White |
| Extra Early Red Flat | Aug. 1 | 242 | 48 | Red |
| Extra Early White Pearl | July 15 | 181 | 29 | White |
| Giant Rocca of Naples | " 28 | 484 | 3 | Brown |
| Giant Red Rocca | " 28 | 363 | 93 | Red |
| Giant White Italian Tripoli | Aug. 1 | 242 | 25 | White |
| Giant Yellow Rocca | " 1 | 435 | 14 | Yellow |
| Large Red Wetherfield | " 1 | 242 | 56 | Red |
| Mammoth Silver King | " 1 | 242 | 4 | White |
| Michigan or Ohio Globe | July 28 | 242 | 81 | Brown |
| Oregon Red Danvers | Aug. 1 | 181 | 58 | Red |
| Philadelphia Silver Skin | " 1 | 121 | 82 | White |
| Pink Prizetaker | July 28 | 242 | 81 | Light R |
| Prizetaker | Aug. 1 | 242 | 86 | Yellow |
| Red Bermuda | " 1 | 272 | 16 | Red |
| Red Victoria | July 28 | 363 | 26 | Red |
| Southport Red Globe | Aug. 1 | 242 | 79 | Red |
| White Globe | " 1 | 121 | 76 | White |
| White Portugal | July 21 | 121 | 86 | White |
| White Silver Skin | Aug. 1 | 181 | 72 | White |
| Yellow Globe Danvers | July 28 | 181 | 75 | Yellow |
| Yellow Flat Danvers | " 21 | 181 | 77 | Yellow |

Description of the best six varieties.

Australian Brown: Bulb medium size, medium thick; skin hard, thick, brown; flesh firm, white.

Giant Red Rocca: Bulb medium size, flat, pointed at both ends; skin thick, red; flesh red.

Michigan or Ohio Globe: Bulb medium size, round; skin thick, brown; flesh firm, white.

Pink Prizetaker: Bulb large, round or oblong, pointed at both ends; skin light red, flesh light red.

Prizetaker: Bulb medium size, thick; skin yellow; flesh firm, white.

Southport Red Globe: Bulb medium size, round; skin red, flesh firm, red.

## LETTUCE.

Lettuce is the most popular salad plant grown in the United States and is one of the first vegetables ready for use in the spring. In this climate it can be grown successfully only in the spring. It requires cool weather for its best development. Some of the most tender varieties will sunscald here in the last of April and May and the most hardy varieties are seldom good after the first of June. If there is plenty of rain in the fall season and the frost does not come until late, a crop can be grown then with little trouble. In specially cool and favored locations the plants may be grown in July and August but the leaves are usually too thick and tough for use.

The seed may be planted in the hot bed in February and the plants grown there to maturity. The bed must be well ventilated and watered. The seed should be drilled in rows from six to twelve inches apart and the plants thinned to three inches apart in the row as soon as they are well started. If it is desired to grow large plants they should be thinned to ten or twelve inches apart in the row and the rows should be ten or twelve inches apart. The plants may be started in the hot bed or a small box in the house and then transplanted to the open ground. This crop will not pay for the work of transplanting however in Oklahoma with the present prices of land and labor.

The seed should be sowed in the open ground in March. The land should be plowed and prepared for the crop two or three weeks before the seed is planted. The seed should be drilled in rows twelve to eighteen inches apart and covered with about one inch of soil. If the soil is very dry the seed should be planted deeper and if the soil is very wet the seed should not be placed more than one-half inch deep. The plants should be thinned to two or three inches apart in the rows as soon as they are well started. As soon as the largest plants are large enough to use they can be taken from the bed and the thinning process continued until the entire crop has matured. The cultivating should be done with the hoe or the wheel hoe. The surface soil should be stirred and loosened frequently and kept free from weeds and grass. If the land is well prepared for the crop it will require very little cultivation.

Lettuce is frequently grown as a companion crop with cabbage, beans and early potatoes. It can be planted between the rows or in the row with the other crop. If planted early and well cared for it will be out of the way before the other crop needs all the land. A small bed will usually supply a family with plenty and there is little need of planting it with another crop.

There are now a great many varieties in cultivation. The experiment station has grown as many as thirty-five varieties in one season There are many varieties that so closely resemble each other that a person not skilled in identifying varieties could not distinguish them. There are a few varieties that do very well in Oklahoma. The curly leaf lettuce as a class is better adapted to this climate than the head lettuce. The Grand Rapids, Early Curled Silesian, Black Seeded Simpson, and Simpson's Early Curled are about the best varieties of the curly leaf class. Hanson is a very good lettuce with large curly leaves and in some localities forms a distinct head but as grown at the experiment station it is not head lettuce. The Early Prize Head, Silver Ball, Paris White Cos and New York are about the best varieties of the head lettuce.

Description of the best varieties.

Grand Rapids:—plant large; leaf large, light green, curly. One of the best varieties grown.

Early Curled Silesian:—plant large; leaf large, light green, curly.

Black Seeded Simpson:—plant very large; leaf large, light green, curly, sometimes forming a large loose head. A very good variety.

Simpson's Early Curled:—plant medium size; leaf medium size, light green, curly. The plant sends up the seed stalk very early. A good early variety.

Hanson:—plant medium size; leaf medium size. dark green curly, very tender. This sometimes forms a small loose head.

Early Prize Head:—plant small; leaf small, dark green tinted with red; head small. A good early variety.

Silver Ball:—plant large, leaf medium size, dark green bleaches to nearly white in the head; head large, compact.

Paris White Cos:—plant large; leaf medium size, dark green; head large, loose.

New York:—plant large; leaf large, dark green, slightly sunscalded; head large, compact.

## RADISH.

Radishes require a rich sandy loam for their best development but they can be grown on all most any kind of fertile soil. They are grown only in the summer in this climate. They require a cool temperature and plenty of moisture in the surface soil. The plants are small and the roots short so they are necessarily surface feeders. They are of quick growth and any check in their growth is sure to impair the quality. The early sorts grow to maturity in from four to six weeks from the time of germination. They should be pulled and used before they are mature. The roots that mature become woody and pithy and are not fit for use.

The earliest of the turnip varieties can be planted in a hotbed in the late winter and grown there without difficulty. The seeds should be drilled in rows six to eight inches apart and the plants thinned to one inch apart in the row. The seed should be covered about one-half inch deep. They require very little attention after the planting is done. The soil should be kept moist and free from weeds and surface stirred to keep it loose.

Radishes may be planted as a companion crop with peas and onions, but in Oklahoma there is little need of such close planting. The radishes germinate very rapidly and soon break the crust of the soil and show the rows so cultivation can be carried on with greater facility. The earlier kinds will be out of the way before the accompanying crop is large enough to use all of the land. The seeds should be drilled in rows from ten to fifteen inches apart and the seeds covered about one inch deep. The young plants should be thinned to two or three inches apart in the row. If the soil is fertile and contains a good supply of moisture the plants will do very well without thinning, but will always grow faster if they are thinned. They should be cultivated frequently enough to keep the surface soil loose and open.

Most of the varieties of radishes do well and there is but little difference in the varieties of the same class. The early turnip varieties are the best for planting in hotbeds and in the open for an extra early crop. The long rooted varieties are better for later planting and should be used for the main crop. The summer radishes can be planted later in the spring and will be ready for use in May and June. The winter varieties may be planted in August and September the same as turnips. They will seldom make a crop however and are not worth planting.

### SALSIFY OR OYSTER PLANT.

Salsify is a vegetable that is seldom found in the farmer's garden in Oklahoma. It is not a staple vegetable and perhaps will never become such but it should be planted in every garden in the territory. It is easily grown and can be left in the ground nearly all winter without loss. When properly prepared it makes a very good soup with a taste very much like oyster soup.

The seed is planted in the early spring about the same as onion seed and the plants are thinned and cultivated in about the same way. The plant is of slow growth and requires the whole season for roots to mature. Level, clean cultivation is all that is necessary.

There are few varieties and they can hardly be distinguished from each other except by the size of the plants. The Sandwich Island is perhaps the best variety now in cultivation.

### BEANS.

Garden beans are commonly divided into two classes, the bush beans and the pole beans. The bush beans are more commonly grown in Oklahoma than the pole beans because they do not require as long a season.

The season of the garden beans that are planted in the spring is limited by the dry weather in July and August more than by the early frosts in the fall. Beans should not be planted until all danger of frost is passed.

Bush beans should be drilled in rows from two to three feet apart and the plants thinned to four or six inches apart. The seed should be covered with about one or two inches of soil depending on the amount of moisture present. The land should be cultivated from the time the plants are up until the growth has stopped. The cultivation should be shallow and leave the surface soil level and well pulverized. Good shallow cultivation given with a horse cultivator and hoeing to keep the weeds and grass down is the best kind of treatment that can be given.

The bush beans have a strong tendency to ripen their entire crop at the same time. This characteristic is very desirable in growing a crop for dry beans but for green beans this tendency should be overcome as much as possible. The best way to keep the vines in bearing longer than their natural bearing season is to keep the green pods pulled off as soon as they are large enough to use. This practice if closely followed will often lengthen the bearing season two or three weeks.

There are many varieties of bush beans now on the market. There are a few groups of varieties that do well in this locality with little care and attention. The Valentine varieties have done well and are about the best varieties for snap or green beans but they are not of good quality for dry beans. The plants are medium to large; pods round, green, tender; bean medium to large, blotched and speckled with various shades of red and brown. Early Mohawk and Long Yellow Six Weeks are also very good bush beans for green beans. Early Mohawk is a medium to large kidney-shaped bean, brown speckled and blotched with dark red. Long Yellow Six Weeks is very similar to Early Mohawk only it is solid brown. Large White Marrow and White Kidney are the beans most commonly used for dry beans. These varieties are medium sized, white, kidney-shaped beans very much like those just described in plant. Among the best varieties of the wax or yellow pod beans may be mentioned the Golden Wax, Dwarf Black Wax, and Refugee Wax. Golden Wax is a small bean, white, covered with blotches of red. Dwarf Black Wax is a medium sized black bean. Refugee Wax is a small brown bean covered with blotches of black. The Bush Limas make a good crop in good seasons but they require more moisture and a longer growing season than the common kidney beans.

## PEAS.

Garden peas are commonly divided into two classes on the form of the seed, the smooth seed and the wrinkle or sugar peas. The smooth seed varieties are the most hardy and should be planted early in March.

Varieties with wrinkled seed may be planted two or three weeks later. The dwarf varieties should be drilled in rows from one to two feet apart with the plants two or three inches apart in the row. The tall varieties should be drilled in rows three feet apart with the plants six to eight inches apart in the row. Peas should be cultivated the same as beans. The young peas should be gathered as soon as they are two thirds or three fourths grown if the vines are to be kept in bearing.

All the varieties that are eighteen inches high or over should be supported by some form of trellis. The cheapest material that can be used on most farms for this purpose is small brush or limbs. The stem can be sharpened and stuck along in the row and serve all the purposes of a wire trellis.

There are many varieties of peas on the market. Tom Thumb is the leading early dwarf variety. The vines are about ten inches high, pea smooth.

Little Gem is the leading wrinkled variety. There are several varieties of this class and all of them are good but later than Little Gem.

Telephone is the leading wrinkled variety of the tall, late peas. The vines are four or five feet high.

White Marrowfat is the leading variety of the tall, late, smooth peas. The vines are four or five feet high.

## CABBAGE.

A report of variety tests of cabbage was given in Bulletin No. 52, a few copies of which are still available for distribution.

O. M. Morris, Horticulturist.

# Oklahoma Agricultural Experiment Station,

STILLWATER, OKLAHOMA.

BULLETIN NO. 57, MARCH, 1903.

# DIRECTIONS FOR USING VACCINE FOR THE PREVENTION OF BLACKLEG IN CATTLE.

## INTRODUCTION.

The Experiment Station has published several short articles giving in a brief way the general character of blackleg and describing the best means of preventing the disease, as well as advising such sanitary precautions as seem best to follow under the circumstances. The result is the very general practice of vaccination, stockmen generally recognizing the fact that blackleg can be prevented in this way.

All of the work in connection with the distribution of the vaccine has been kept in the form of records which will be of value as the work progresses. Much of the laboratory work has been done by Mr. F. L. Rector, an assistant in the veterinary department. Those who use the vaccine can very materially add to the general information on the subject by reporting any unusual occurrence noticed in connection with the use of the vaccine.

## VACCINE DISTRIBUTED.

In October 1899, the Oklahoma Experiment Station received 1000 doses of vaccine from the Bureau of Animal Industry, U. S. Department of Agriculture, for free distribution to the stockmen of Oklahoma. Previous to this time no effort had been made by the Experiment Station to give any material assistance in controlling in a systematic way the prevalence of the disease. The inquiries received indicated that blackleg was especially prevalent, and that most stockmen regarded the disease as practically incurable as well as dangerously infective. Usually the letters of inquiry asked for advice as to the best means of disposing of the dead animals and what could be done to prevent the excessive losses from the disease. Those inquiring for a preventive were referred to the Bureau of Animal Industry and the usual advice in regard to burning or burying was given in reference to the disposal of the dead animal.

The small amount of vaccine received was soon distributed and the demand soon became so general that it was thought advisable to undertake to supply it by sending out vaccine prepared by the Experiment Station. Some time and expense was necessary to equip the laboratory for work of this kind, and in addition material had to be secured from which to make the vaccine. Since the work has been started the only available material has been such as was furnished by parties who were losing cattle. In order to secure this diseased meat letters were sent out describing the necessary precautions to be observed in securing meat from animals that had died from blackleg. About one-half of the material received at the laboratory was in such a condition that it had to be destroyed. In many cases it was filled with dirt and sand and in others it had not been sufficiently dried, showing in many cases the effects of decomposition, while in two cases the material proved to be from animals that had not died from black leg. This very uncertain supply of material frequently left the Station without vaccine to fill the requests. This unsatisfactory arrangement was necessary on account of the lack of funds to carry on the work in a more systematic way. The special provisions that have now been made for the distribution of vaccine will enable the Experiment Station to purchase and kill as many animals as will be needed to supply the cattlemen of the Territory with vaccine. This arrangement will place the work on a substantial basis, it will enable the applicant for vaccine to secure it promptly and, in many cases, losses will be prevented that were before unavoidable.

The first vaccine sent out from the Station that had been manufactured in the veterinary laboratory was March 1, 1900. From that time until June 30, 1902, 184,310 doses were sent out. Of this amount 8,735 doses were sent out between March 1, 1900, and June 30, 1900. The following table shows the number of doses and requests by months from July 1, 1900 to June 30, 1902.

### DISTRIBUTION OF BLACKLEG VACCINE.

| JULY 1, 1900, TO JUNE 30, 1901 | | | JULY 1, 1901, TO JUNE 30, 1902 | | |
|---|---|---|---|---|---|
| Month | Number of Requests | Doses | Month | Number of Requests | Doses |
| July | 3 | 120 | July | 42 | 4965 |
| August | 17 | 685 | August | 22 | 990 |
| September | 26 | 2425 | September | 59 | 7460 |
| October | 74 | 7070 | October | 241 | 23570 |
| November | 69 | 7415 | November | 307 | 22135 |
| December | 63 | 5935 | December | 148 | 12530 |
| January | 31 | 4215 | January | 103 | 8500 |
| February | 51 | 4645 | February | 92 | 4270 |
| March | 58 | 4505 | March | 142 | 10500 |
| April | 57 | 5610 | April | 165 | 11265 |
| May | 69 | 6030 | May | 152 | 11605 |
| June | 43 | 3300 | June | 79 | 6100 |
| | 561 | 51955 | | 1552 | 123620 |

From July 1, 1902 to May 1, 1903, 92,855 doses have been sent out, making a total of 277,165 doses that have been furnished without any expense whatever to the parties who have used the vaccine.

## HOW TO GET VACCINE.

Considering the general prevalence of the disease and the efficiency of vaccination in preventing blackleg it is evident that the total amount of loss that has been prevented is considerable. The benefit to stockmen has been of so substantial a character that arrangements have been perfected that will enable the Experiment Station to continue the manufacture and distribution of all the vaccine needed by the stockmen of Oklahoma.

The policy of the Station in sending out vaccine has been to supply all the vaccine needed on receipt of a request from the party who intended to use the vaccine. Some have undoubtedly taken advantage of this liberal method and secured vaccine for commercial purposes, but this has been a comparatively rare occurrence. The accommodation to the man who wants a few doses of vaccine and who will use it as soon as he can get it is enough to outweigh the few cases where deception is practiced. No special form of application is required. A card or letter stating the number of doses wanted, that the applicant is a citizen of

Oklahoma, and that the vaccine is for use on cattle owned by him, sent to the Experiment Station will secure all the vaccine needed and directions for its use. Records are kept of all requests and vaccine sent out, and at some future time a printed list of questions will be sent to all who have received vaccine, asking for information in regard to the various questions concerning the prevention and controlling the disease.

## DISTRIBUTION AND NATURE OF THE DISEASE.

Blackleg is found to some extent in nearly all countries of the world. Temperature and altitude do not seem to be very important in limiting the disease as it is very common in the northern states and in high altitudes. The distribution of the disease in the United States is becoming very well known through the systematic efforts that are being made by the government and the various states to prevent the great amount of loss which occurs every year. Some of the Atlantic and Gulf states are practically, if not entirely free from the disease, while the states immediately west of the Mississippi river are generally infected, especially Texas, Oklahoma and Indian Territories, Kansas, Nebraska, Colorado and North and South Dakota. In the states named the per cent of infected counties varies from 46 in Texas to 100 in Oklahoma. Applications on file show that the disease is present in every county in Oklahoma, though more especially in the southern and western counties.

Cattle over three years of age are practically immune to blackleg, while younger and rapidly growing cattle are very susceptible. In some localities the general opinion prevails that calves under six months of age will not have the disease. This is a mistake as numerous letters received will show. There are many cases of the disease in young calves and unmistakable cases are occasionally reported in three and four year-olds. Range cattle are not as susceptible as well-bred animals and this may explain the fact that blackleg is more common among well-bred animals than on ranges where no attention is given to the improvement of the stock. The disease is also more common, in proportion to the number of animals, in the agricultural portions of the Territory than in the portions devoted entirely to range purposes.

The germ that causes blackleg is a short rod-shaped body, about one three-thousandth of an inch in length. They are always found in large numbers in the bloody fluid and black muscle at the seat of the disease and for this reason the material should be buried and not allowed to get scattered over a pasture. The germ will grow only when oxygen is kept from it and the growth is always accompanied by gas production. Numerous experiments have been conducted to determine the length of time the germ will live under varying conditions, the results always showing the germ to be very resistant, principally on account of the spores that are formed. It is practically impossible to duplicate, in an experimental way, the conditions existing in pastures and to which cattle are exposed. Experiments conducted in the laboratory show that the germ is killed in twenty to twenty-two days when exposed to direct sunlight. The same results would occur in pastures if all of the infection could be acted on directly by the light. The germ is not easily killed by either heat or chemicals and the cold of winter has no effect whatever in ridding a pasture of infection. One of the surest means of freeing pastures of infection is to burn them in the early spring. This applies not only to blackleg infection but to any infection that may be present. A two per sent solution of carbolic acid will not kill the germ in dried material in less than fifteen to twenty hours. For disinfecting purposes a five to eight per cent solution of carbolic acid should be used or a solution of corrosive sublimate one to one thousand. Lime thoroughly applied to an infected area, as where an animal has died in the pasture or barn, will generally kill the infection. The temperature of boiling water acting for twenty to twenty-five minutes is necessary to destroy the germ in fresh material while the dried virus will not be killed by the same temperature in six hours, the difference being caused by the formation of spores in the dried material.

Even though blackleg is one of the most comomn diseases there are some things in connection with it that are not easily explained or very well understood. The disease has been observed here, in many cases, in pastures where no such disease had been for at least ten years. The question naturally arises as to whether the germ will live for that length of time outside of the body or whether the infection was brought into the pastures in some unknown way. Experiments just referred to indicate that sun light will soon disinfect all material it can reach as small amounts of diseased meat placed in the sun were found to be sterile in from twenty to twenty-two days. Only twenty-seven days were necessary to kill the germs of anthrax, this being one of the most resistant germs known. The infection that lives for any considerable length of time in pastures must necessarily be protected in some way and it is possible that such conditions as moisture and warmth cause the germ to grow and when brought to the surface of the ground, by either rains or movement of animals over the ground, it is able to produce the disease when, by means of a wound or food, it gains entrance to the body of a susceptible animal.

## SYMPTOMS.

The symptoms of blackleg are so characteristic that there need be no mistake made in recognizing the disease. The general symptoms are loss of appetite, dullness and high fever, followed by supension of rumination and general depression. They are not essentially different from the symptoms of any other acute infectious disease. Within a very short time after the first symptoms are noticed there appears a swelling or tumor on some portion of the body. These tumors may occasionally be noticed as the first symptom of the disease, the animal still having a good appetite, looking bright, but lame from the effect of the swelling. The swelling or tumor is the most important feature of the disease and is always associated with lameness when the swelling is on any part of the fore or hind leg. These swellings may be seen on any portion of the body except that part of the limbs below the knee or hock or on the tail. The most common location is on the thigh or shoulder. These tumors are at first hot and painful, but spread rapidly and soon become filled with gas, as can be determined by passing the hand over the swelling when a crackling sound is heard. These tumors frequently increase rapidly in size and may cover a large part of the body in a few hours. After the gas begins to form the tumor is not sensitive to the touch and the skin becomes cool, dry, and parchment-like over the center. Opening the tumor causes no pain but allows the escape of a frothy red liquid which has a disagreeable but characteristic sour, ordor. If the skin is removed from these swollen places the flesh will be found very bloody and black, looking as if badly bruised. Owing to this black and discolored condition of the flesh, which can always be seen if an examination is made, the disease has been called blackleg. The course of the disease varies, but with very few exceptions proves fatal in from twelve to twenty-four hours after the animal is known to be sick. This time varies however, especially when older cattle are attacked; in this case the disease is in a milder form and the animal may recover.

## PREVENTION.

It is well to state at the outset that there is no curative treatment for blackleg. There are occasional cases of the disease that will recover but in the average case of blackleg no favorable results can be expected from any medical treatment. In those cases that do recover the animal is immune to subsequent attacks. All the various methods adopted as a means of prevention may be placed under such sanitary measures as will prevent the spread of the disease and vaccination, the various forms of prevention and treatment commonly employed being generally useless.

Various methods of treatment were practiced both as a means of prevention and as a cure before the process of vaccination was introduced, and these popular remedies are used at present by a great many stockmen. One of the most popular remedies is to bleed from the jugular vein; this is used as a cure as well as a preventive. It is of no value whatever as a cure and of very doubtful value as a means of prevention. 'Nerving' is a remedy that is practiced by a great many; this consists in cutting a small artery in the back part of the foot and allowing blood to escape. Setoning is practiced to some extent and consists in introducing a piece of leather, rope or poke root under the skin, in fact anything that will cause suppuration and a running sore. When the nature of the disease is understood the uselessness of such methods will be seen. The general practice of such methods as named above was very common before the process of vaccination came into general use. Cutting and rôweling the animal only increases the chances for infection through the wounds made and amounts to nothing whatever as a cure or a preventive. The Experiment Station has no remedies to offer as a cure because practical experience has shown that the disease is almost invariably fatal. A great many want to know if vaccination is a cure, but we do not believe that it has any value whatever except to prevent the disease. If a remedy could be found that would cure fifty per cent of the cases it would be no argument for its use to the exclusion of vaccination. Available statistics on the matter show that where vaccination is not practiced the loss is above three and one-half per cent while after vaccination it is less than one-half per cent.

The manner of disposing of dead animals is to be considered as one of the important things in controlling the disease. There are very few diseases with which the stockman and farmer are so familiar as they are with blackleg; its general distribution, the class of cattle affected and the well marked symptoms combine to make it one of the easiest recognized. But in most cases all fail to appreciate the fact that the disease may become scattered over a pasture or farm by allowing a carcass to remain on the surface of the ground. There is no necessity of opening the animal and the skin should never be removed, on the contrary either bury or burn the animal where found if possible. Burying is the most practical way of disposing of the body as it frequently happens there is not wood enough available to burn the animal. The carcass should be buried at least four feet below the surface and all soil, bedding, etc. that is soiled with the blood should be placed in the pit with the body. It is of the greatest importance that the stockman should recognize the fact that any of the flesh or blood of the animal is infected and while it may not cause any immediate loss it may be the cause of considerable loss in the future. Opening the tumor before the animal dies should not be practiced as the animal will then scatter the infection as long as it can move about the pasture.

Article 1, chapter 2, session laws of Oklahoma, 1899, provides "That it shall be the duty of the owners of any swine or other domestic animals dying from cholera or other diseases, within twenty-four hours after their death, to cause the carcasses of such animals to be buried or burned up" and provides further that "any person violating the provisions of this Act shall be deemed guilty of a misdemeanor, and, upon conviction thereof, shall be fined in any sum not to exceed $50.00, or be imprisoned in the county jail not more than 30 days."

## VACCINATION.

There is considerable interest attached to the history and development of vaccination in this particular disease as it illustrates what may be done in the way of prevention when every remedy imaginable has failed as a cure. Arloing, Cornevin and Thomas were the first to demonstrate that animals may be protected by inoculating them with a weakened virus obtained from animals that had died from blackleg. There is no other disease of either man or animals where vaccination is so uniformly successful as a preventive measure as is the case with blackleg. The per cent of animals taking the disease after vaccination is less than it is in small pox in man after vaccination, yet there is no disease where individual succeptibility varies as greatly. In some instances the dose of vaccine usually given has been known to prove fatal because the animal was so susceptible and in other cases the usual dose has failed to protect against the disease because the animal was more resistant than usual.

The vaccine sent out from the Experiment Station is prepared in the laboratory of the veterinary department and is put up in ten and twenty-five dose packages. As stated before, the vaccine is made from the diseased meat secured from animals that have died from blackleg. This meat is dried, pulverized, and then mixed with water, after which it is placed in a hot air oven and exposed to a high temperature for several hours. This weakens the strength of the virus until it can be used as a vaccine and produces no noticeable results after inoculation, while if a small amount of material, before attenuation, was inoculated into an animal it would prove fatal.

The first vaccine prepared was known as double vaccine, and consisted of two vaccines, one a weak virus, made at a very high temperature and the other a stronger virus made at a temperature several degrees lower than the first. The weak virus was used first and in about ten days the stronger virus was injected. This process required the handling of stock twice, which involves a great deal of work on ranges where several hundred head of cattle are to be vaccinated. In order to avoid handling cattle twice the preparation of a single vaccine was undertaken and several years' experience in its use has proven beyond doubt that it is effective and can be administered with one-half the work necessary to use the double vaccine.

The finished vaccine is a brown powder having an odor similar to that noticed coming from the blackleg tumor when opened. To properly administer the vaccine a hypodermic syringe and other pieces of apparatus are necessary, all of the apparatus used being commonly called a vaccinating outfit. Before the vaccine can be administered it must be mixed with water and all of it that will do so allowed to go into solution. After the powder is treated in this manner it is filtered through a thin layer of absorbent cotton and the fluid that comes through is the material to be used for vaccination. The various steps necessary in preparing and using the vaccine may be enumerated as follows: After you have everything thoroughly cleaned in a five per cent solution of carbolic acid, proceed as follows.

(1) Place in the mortar as many doses of the powder as you have cattle to vaccinate unless there are more than one hundred head, when it will be better to make up a second lot.

(2) Moisten the powder with enough water to make a paste which is thoroughly ground with the pestle, after which add as many cubic centimeters of water (the syringe holds five cubic centimeters) as you have doses of vaccine and then work the mixture thoroughly.

(3) Place a very thin layer of cotton in the funnel and moisten it with water after which pour the fluid containing the vaccine into the funnel and collect the fluid in a clean bottle or glass vessel.

The careful observation of the directions given in the three steps will give the vaccine carefully prepared and ready to be injected into the animal.

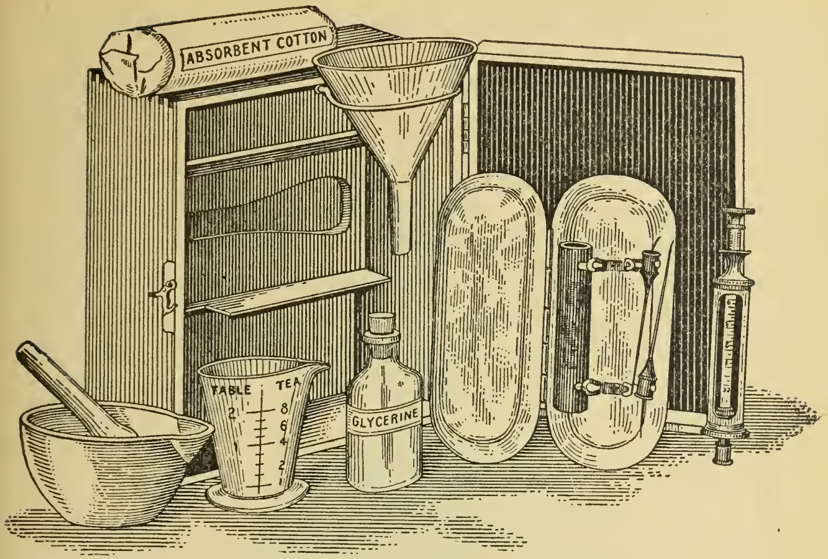


FIGURE 1. VACCINATING OUTFIT.

(Supplied by the Experiment Station for $4.50.)

There are several little details connected with the process of vaccination that are easily overlooked and they may very materially affect the results and it is on account of the failure to observe these little details that some of the bad results following vaccination are due. The liquid, when filtered through the cotton, should be cloudy, but if the layer of cotton is too thick it will be clear and have less of the vaccine in it than when properly filtered; or if the vaccine is filtered before being thoroughly worked in the mortar it will not contain the necessary amount of the virus. After the vaccine is filtered and allowed to stand for a few minutes a sediment is deposited which consists of vaccine. If, without shaking the bottle, the syringe is filled there will be very little vaccine in each dose given while the last from the bottle will probably contain three or four times the necessary amount of vaccine, which in some cases is likely to prove fatal. When possible the vaccine should be prepared at home and taken to the stock pens in small bottles from which it can be drawn with the syringe, being careful to thoroughly shake the bottle before filling the syringe. The vaccine will not keep after it is put into solution, consequently no more vaccine should be made up than is to be used at any one time.

To administer the vaccine, after it has been prepared, a good heavy hypodermic syringe is necessary. Such a syringe is shown in figure two.

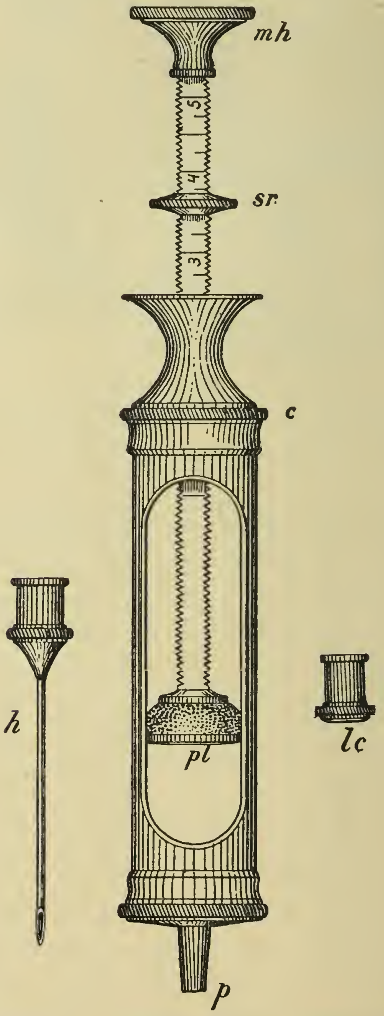


FIGURE 2. HYPODERMIC SYRINGE.

The syringe holds five cubic centimeters (five doses) and the piston is graduated from one to five with finer subdivisions between the figures.

The regulator, or guard on the piston, can be placed at any position and the dose regulated depending on he age of the animal to be vaccinated. For any animal over six months of age the full dose should be given, which is one cubic centimeter, and fractional parts of a dose should be given to young calves depending on their age and development.

When vaccination was first practiced the method was to vaccinate in the end of the tail or the ear where the connective tissue was very dense. This method has been abandoned as it is more difficult to vaccinate in this region than other parts of the body where the skin can be picked up in a fold. The most convenient place to vaccinate is on the side of the neck or shoulder as the skin is thin in this region and the operation is attended with less risk to the operator than in any other position. The following directions are sent out with every order of vaccine filled. Part of the process of vaccination has been described but the entire directions are given here in full.

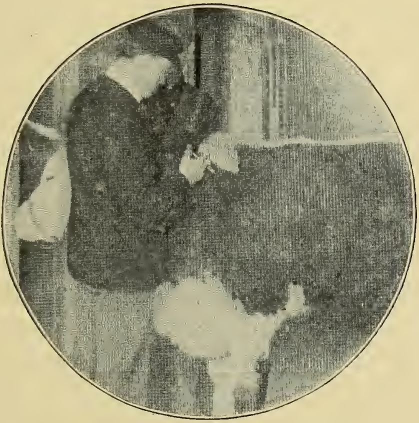


FIGURE 3. VACCINATING.

Before the vaccine is prepared all of the utensils, including the syringe, must be cleaned in a five per cent solution of carbolic acid, or they may be boiled for ten minutes. After cleaning remove from the water and dry with a clean towel that has been boiled. Place the vaccine in the porcelain mortar and moisten with a few drops of water which has been allowed to cool. Work the powder with the pestle or glass rod and add slowly as many cubic centimeters of water as you have doses of vaccine. The syringe used for vaccinating purposes contains five cubic centimeters and may be used for measuring the water. After the water is added the fluid is thoroughly stirred so as to get as much of the vaccine in solution as possible. To filter the vaccine, place in the funnel a small piece of absorbent cotton, moisten with sterile water and press it down into the funnel. Stir the mixture of vaccine and water and before it has time to settle pour it into the funnel under which you have placed the measuring glass. The fluid should not come through clear, but should be cloudy, and if it is clear the layer of cotton in the funnel is to thick. The object of filtering is to get out the coarse particles to prevent the needle of the syringe from clogging.

When possible the vaccine should be prepared at home and carried to the stock lots in a small bottle from which the vaccine may be drawn with the syringe. If the vaccine is allowed to stand for a short time a sediment will form on the bottom of the bottle, therefore the bottle should be well shaken before the syringe is filled. No more vaccine should be prepared than is to be used at that time as it will not keep in solution.

The syringe holds five cubic centimeters and the piston is graduated from one to five with finer divisions between the figures. The regulator on the piston can be placed at any position. The dose for an animal over six months old is a cubic centimeter, or the distance from one figure to the next, as from four to five. Fractional parts of a dose must be given to younger cattle depending on their age and development. The best place to vaccinate is on the side of the neck or shoulder as the skin is thin in this region. Pass the needle of the syringe through the skin and then adjust the peg of the syringe in the needle and inject the dose which has been measured off on the piston. Withdraw the needle and syringe together and to prevent any of the vaccine escaping through the opening made by the needle press the skin tightly around the needle as it is withdrawn.

After vaccinating, the syringe should be thoroughly washed in a five per cent solution of carbolic acid, carefully dried and the brass wire placed in the needle.

### TIME FOR VACCINATING.

There is no special time for vaccinating as it may be done at any season of the year. The disease is much more common during the spring and fall than at other seasons and if the vaccination was attended to during the winter and summer it would very materially lessen the amount of loss. It is best to vaccinate all young animals at least twice and if they are vaccinated before they are six months old then they should be vaccinated three times. Vaccinating a young calf does not give it protection for any great length of time so that it should be vaccinated a second time when six months old. If calves are given a full dose of vaccine at six months and the second vaccination at a year old in almost all cases you will have given the animal perfect protection against any future chance of taking the disease.

A great many inquiries are received asking if it is safe to perform such operations as dehorning, castrating or branding at the time the animal is vaccinated. We have very few replies to direct inquires asking for information in regard to such practices. Persons who have reported the practice of such methods have not found it to be dangerous in any way. The advantage of doing all of the work of this kind at one time is apparent as it saves handling the stock a second time.

L. L. Lewis,
Veterinarian.

# Oklahoma Agricultural Experiment Station,

STILLWATER, OKLAHOMA.

BULLETIN NO. 58, JUNE, 1903.

# FATTENING STEERS; USING COTTONSEED, COTTONSEED MEAL, WHEAT MEAL, WHEAT STRAW AND HAY.

## I—CONDITIONS AND RESULTS.

### INTRODUCTION.

The steer feeding experiments herein detailed were carried on during the winter of 1901-2 at the Oklahoma Experiment Station farm. The plan for the winter's steer feeding experiments had been to continue a series of experiments, that had been under way for the two previous winters, in which corn meal, Kafir meal, alfalfa hay and Kafir stover were being compared as beef producers, but due to the condition, related later, the work was postponed to a more opportune time for completion, and steer feeding work with cottonseed products, which had been contemplated for some time, was started with the view of continuing it at some future time.

The widespread drouth of the summer of 1901 caused a great shortage in the corn crop of the Mississippi valley and central west, a total failure in many parts, and a material shortage in other feeds, which was followed by a corresponding rise in the price of feed stuffs, and a decline in the price of feeding stock throughout the country. Corn or Kafir corn was not obtainable in the locality of the experiment station at anything like a reasonable price in comparison with other feed stuffs, hence they were not used in the feeding experiments of the winter. Due to the fact that a good average wheat crop was harvested the summer of 1901, wheat was a much more available stock food than corn in this locality, as well as in many others in the west, and was cheaper in price, and for these reasons it was substituted in our rations where corn would have been used under ordinary circumstances.

The extremely high prices of feeds in the fall of 1901 kept many feeders from putting their cattle on full feed and many cattle which ordinarily would have been fattened that winter were roughed through to be fattened later. Due to the low price of feeding steers at this point and a prospect for a fair market for fat cattle in the spring, we predicted that there was as good an opportunity for profit in fattening cattle that winter as usual, and we realized our expectations as we made handsome profits on the steers above the cost of steers and feed.

Not many years ago, nine-tenths of the steers were fattened on corn with anything as corn stover, wheat straw or low grade prairie hay for roughage, and the remark was frequently made, "the less roughage they would eat the more corn they will consume and so much the better." Although this old idea has been hard to eradicate, the ration for the fattening steer is usually much different at the present time and the progressive feeder realizes the importance and economy of adding some nitrogenous feed as the oil meals, mill by-products, alfalfa hay, etc., to the corn to balance up the ration. Although corn will usually constitute the bulk of the most economical ration for fattening steers, there are many instances, particularly in the southern states, where it is wholly left out and in many of these instances other feeds have been used in its place with economy. Some of these are products of the cotton crop. They are very important factors in steer feeding operations today, not only in the South, but in the great corn districts of the Mississippi valley and Central West. Except where alfalfa is very cheap they are probably a necessary portion of the most economical ration for fattening steers in any part of the great beef producing districts of the United States. The true feeding value of the cottonseed products is not understood by many and they are wastefully used in a large number of cases.

## SELECTING AND COMPOUNDING RATIONS.

The farmer today who does not consider well the composition or digestibility of the feeds to be used and compare the same closely with the market values of the respective feeds, and use them accordingly, is very likely to come out of his steer feeding operations with the balance on the debtor side of his ledger. He must get the idea out of his head that a pound of cottonseed meal differs but a little from a pound of corn meal, or that a fork full of alfalfa hay is but little different from a bundle of corn stover or wheat straw, and he must not draw the conclusion that whatever feed is the handiest, or costs the least per pound is the article to feed the steer. He must learn that the cottonseed meal and alfalfa hay are foods that belong to a group that are termed nitrogenous foods, since they contain a large per cent of the compound that the chemist calls protein, which is the most important ingredient in the composition of feeds.

If the feeder would investigate he would find that if a few pounds of cottonseed meal were substituted for a few pounds of the corn where nothing but corn and corn stover or wheat straw were being fed the steers, the gains would be increased twenty-five to fifty per cent and the cost of gain greatly reduced although the cottonseed meal might have cost a third more or double as much as the corn replaced. On the other hand if nothing but cottonseed meal and hulls were being fed, if a few pounds of corn or a like feed were added he would obtain better gains from his steers and, as a rule, at a less cost.

Along with the ingredient, protein, found in all feeds, there are two other substances in feeds that are considered in selecting and compounding rations. One of these is known by the name carbohydrates, a substance made up of the starch, sugars and fiber of plants. The third substance is called fat, which is made up principally of the oils of the plants or feeds. The carbohydrates and fats of feeds are very similar in their composition, and perform very much the same functions in building up or maintaining the animal body. They differ in composition from protein, principally in that they do not contain nitrogen, which is a very important element in protein. The muscles, nerves, tendons, blood, etc., of the animal contain a large amount of protein. They are built up in the animal system from life like substances found in the feeds, of which the gluten, that makes wheat gum, which is familiar to all, is a very good example. No matter in what abundance the carbohydrates and fats are furnished in the feeds, they cannot take the place of the protein and if the protein is not present in the feed in sufficient quantity, growth or increase will be retarded accordingly. The scientist has found that in order to obtain the greatest gains on the least amount of feed, the ration must contain these compounds, protein, carbohydrates and fats, in certain proportions and amounts, which vary for the different kinds of animals and under different conditions. The information obtained by investigators has been arranged in tables called feeding standards and others giving the composition and digestibility of the feeds, which if properly used by the feeder will greatly aid him in selecting and mixing the feeds he is to use. The dry matter given in the feeding standards and in the tables giving the digestible nutrients or their composition, is the water free material of the feed. It is given in the feeding standards as a guide in obtaining the proper bulk or volume in the ration.

More space cannot be taken here to explain these terms and related matter that is important for every feeder to know and understand, and if the reader has not informed himself on these lines he is advised to procure some of the current books and station bulletins on feeds and their compositions, or write to the experiment station for reports that have been published here to explain these subjects. A full understanding of the matter will enable the reader to profit much more by the study of this bulletin.

## PURPOSE OF THE EXPERIMENT.

The principal object of this experiment was to study the best combinations and the feeds with which to mix the products of the cotton crop in order to produce the most desirable rations for fattening steers, and to what degree steers so fed should be ripened.

## FEEDS USED.

The local condition at the time of this experiment made it seem expedient to use cottonseed, cottonseed meal, wheat meal, wheat straw, prairie hay and alfalfa hay in our rations.

The cottonseed was purchased at the gins of Stillwater. Some of it was from the first pickings, and some from the late pickings of cotton. It was fed in the condition just as brought from the gins.. The ginners nad not adopted the up-to-date cleaners, consequently the seed had the usual amount of dirt and sand in it, which generally collected in the feed trough more or less after each feed, particularly where the cottonseed was fed as the exclusive grain ration. The seed was considered good average quality and was fairly closely ginned.

The cottonseed meal was purchased from stock produced by the cottonseed oil mills at Guthrie and Oklahoma City, towns 50 and 80 miles from the station.It was from the crop of 1901 and was a first-class article.

The wheat used consisted of both hard and soft varieties raised in this locality, and was very good milling wheat. It was ground fine with a Bowsher No. 8 feed grinder, run by electric power.

The wheat straw was purchased among the farmers who delivered the most of it baled. Due to the open dry season, it was very bright and in first-class shape. The portion which was fed mixed with the grain fed to one lot or steers was cut into pieces about an inch long by running through a power feed cutter.

The prairie hay was from the native meadows in the locality of the Station and contained the usual mixture of grasses found in such fields, although the hay was very free of the weeds that are present in so many native meadows. The hay had been well put up and was of a very good quality.

The alfalfa was raised on the Station farm and was of a good average quality.

### COST OF FEEDS.

The prices, given in Table I, column No. 1, were used in calculating the cost of the rations that were planned to be used at the beginning of the experiment. As the season advanced prices advanced and average prices of these feeds for the time during the experiment are given in column 2, table I, which were taken in computing the cost of the gains of the steers and the profits. The prices given are about twenty per cent higher than the usual price of these feeds in this locality,with the exception of the wheat straw in which there is an increase of three hundred per cent and wheat which is about normal.

### TABLE I.

GIVING COST OF FEED AT BEGINNING OF THE EXPERIMENT AND AVERAGE COST FOR THE TIME OCCUPIED BY THE EXPERIMENT.

| | No. I. Price per Ton | No. II. Price per Ton |
|---|---|---|
| Cottonseed | $14 00 | $16 28 |
| Cottonseed Meal | 25 00 | 25 72 |
| Wheat Meal | 23 00 | * 23 60 |
| Wheat Straw | 4 00 | 5 00 |
| Prairie Hay | 8 00 | 9 89 |
| Alfalfa Hay | | 14 00 |

* 68 cents per bu. and 5 cents per cwt. for grinding.

In determining the combinations and proportion of the feeds to use in the rations at the beginning of the experiment, the prices of the feeds given in column 1, as well as the composition of the feeds were considered.

### STOCK USED.

Twenty-five head of native grade steers raised in the locality of the Station were used in the experiment. With the exception of five head they were purchased by the Experiment Station as yearlings the fall of 1900. The ones then purchased were roughed through that winter, run on grass the following summer, at the close of which they were put into the experiment. When purchasing the steers the idea was kept in mind that they were later to be divided into lots for comparison in experimental feeding and from the time they were purchased a close study was made of each individual with the view of later dividing the bunch into lots for such use. The other five head were purchased in the fall of 1901, a few weeks before the beginning of the experiment.

Shorthorn blood predominated in the bunch but some individuals were considerably mixed. The steers were gathered with the view of representing an average bunch of native grade steers such as are found in Oklahoma. They were very much mixed in quality and mostly quite low, a few were classed as "good," most of them as "medium," and some as "inferior," according to the market classes for feeders. They were taken off the grass in medium flesh, the individuals varying in this respect. They were not as fleshy as good grass steers generally are, as the season had been very dry and for a month previous to October 30, the day they were taken off the pasture, their feed had been a stalk field and dry pasture. At the beginning of the experiment the twenty-five head averaged near 1000 pounds in weight and 18 months in age. From the time they were taken from the pasture until they were put into the experiment, November 26, they were on a preliminary grain and roughage ration, which filled them up fairly well.

The cattle feeders at the cottonseed oil mills, who are purchasers of hundreds of cattle in this country, paid \$3.00 to \$3.25 per hundredweight for feeders in this locality the fall of 1901, and the steers put into this experiment were valued at \$3.25 per hundred weight.

### PRELIMINARY FEEDING.

In order to get the steers well adjusted into lots, and accustomed to the surroundings, and partially on to feed before the experiment proper began, they were handled as follows: On being brought from the pasture October 30, they were at once put on corn stover for roughage and a mixture of one-third cottonseed, one-third cottonseed meal and one-third wheat chop for grain. At first the grain consisted of one pound per day per steer and was raised very slowly and at the beginning of the experiment, November 26, they were receiving only four pounds per day per steer although at one time they had been as high as six pounds. The idea was not to get the amount of grain too high before changing to their special rations. A week was taken in which to make the change from the preliminary grain ration to the special rations of the different lots, which was complete at the beginning of the experiment. Meantime the roughage had been gradually changed.

## OUTLINE OF THE EXPERIMENT.

Where cattle are fattened largely on cottonseed meal, trouble has usually occured when such cattle have been fed longer than ninety to 100 days, and they are usually marketed after so long a feeding period, at the end of which time they are about in such condition as short fed corn cattle, considerably under ripened. Accordingly it was decided to market these steers after about three months feeding.

The experiment proper began November 26, 1901, and closed March 11, 1902, covering a period of 105 days. This time was divided into three equal periods of thirty-five days each which are designated as Periods I, II and III. The experiment, as well as each period commenced in the middle of the forenoon, after the morning's grain had been fed but before the roughage for that day had been fed, and the time of ending corresponded.

The twenty-five head were divided into five lots of five steers each, giving due attention to the important point of so dividing the steers that the lots would be closely comparable, which with our previous knowledge of the steers was done with a fair degree of satisfaction. The groups of five were designated Lots 1, 2, 3, 4 and 5.

Each lot of five steers was put in a separate pen 50x110 feet which contained a well built shed 14x16 feet with the south side open. A grain trough 4x8 feet by 6 inches deep, and a box rack 5x10 feet, with a rail 2 feet above the edge for the steer's neck to go under was the equipment for receiving the feed, where the steers in each lot were fed together. The pens were fairly well drained; fillings were made in the sheds and around the feed racks and boxes with dirt and the yards were not uncomfortably muddy for the steers for any considerable time. The sheds were kept fairly well bedded with some material that the steers would not eat.

Water was furnished in each pen from a tank arranged with an automatic valve to keep the tank full all the time. The source of the water was a large pond, so located that the quality of the water was not first-class and not the most desirable for fattening steers. During the very cold spells the water was kept from freezing by the use of tank heaters. Salt boxes in the corners of the sheds were kept filled by weighing the salt in.

The day's allowance of grain was divided into two equal feeds and fed at 7:30 o'clock a.m. and 5:30 o'clock p. m. The appetites of the steers were watched very closely and they were given all the grain they would eat up clean within a half hour after being fed, up to a limited amount, in some cases limited to prevent scouring, the idea being to give them all they would eat without getting off feed. If a steer refused to eat or left the trough when there was still considerable grain in it, his share or portion of it was taken out at once. This was not followed with lot 5 for as a rule they always left some of their cottonseed and this was not taken out until the next feed was put in. All changes in the amount of the grain rations were made very gradually, as a rule not over one-half pound per day per steer, with several days between changes. Once in a while, frequently no cause could be assigned for it, a steer or several steers would go off feed, and often take to scouring. At such time the grain ration would at once be reduced half for several feeds until the steer or steers were all right. It always brought about a speedy recovery, generally in a day's time.

The roughage was fed once a day about 9:30 o'clock in the morning after the refuse of the preceding day had been removed. The idea was carried out to limit the prairie hay to the amount prescribed in the rations planned at the beginning. Of the straw, they were given all they would eat and from a fifth to a third more was fed than was eaten, but still most of them did not eat what was calculated for them in the starting rations. The feeds were all carefully weighed and sampled for analyses to be made at the chemical laboratory.

At the time of sampling, from one to three weeks' allowance of the feeds were weighed up, and as a matter of regularity, this was weighed again when fed to the steers daily. In the cases where more than one grain was in the ration, these were thoroughly mixed when the week's allowance was weighed out. The hay and straw were weighed up separately but were thoroughly mixed at the timeof feeding. In the lot that had the cut straw fed with the cottonseed meal, these materials were mixed in the feed trough at time of feeding. As the refuse was gathered it was stored until the end of each period when it was weighed at the time of sampling. Before subtracting it from the feed fed it was calculated to the same water content as when fed.

The steers were weighed individually on a small bullock scale. Each steer had a different number which was made in the ears by a system of notches. For the beginning weights of the experiment and the closing weights of each period of thirty-five days, weighings were made on three consecutive days and an average of these weights was taken for the weights from which to calculate the gains. In addition to this, one weighing was made at the beginning of every seventh day to aid in studying certain matters. On weigh days the covers on the water tanks were closed in the morning before the steers had time to drink, and the steers were weighed at 8:00 a. m. ,after the morning grain had been eaten.

Two fairly thrifty shoats were placed behind each lot of five steers at the beginning of the experiment and the same individuals were kept there until the close of the experiment. When put into the pens the lots of pigs averaged 176 to 220 pounds. It was not anticipated from our previous experience that the hogs would be able to obtain much sustenance in the droppings of the steers. Judging by former work we knew that they would not do at all well if compelled to live wholly on such droppings, no matter how much they had access to, so the plan was adopted to feed them some grain additional. This was ground wheat in all lots and the amount was varied from time to time as a matter of study. The idea was to give a very light feed in order to force the pigs to utilize the droppings, although they might not do first-class in the meantime.

The season taken altogether was fairly favorable for steer feeding. The cold weather set in earlier than usual, December being much colder than ordinarily, several days reaching zero or near to it. A couple of light snows fell during this month. Freezing and stormy weather prevailed the latter part of January and first of February, which time coincided with the latter part of the second period that closed February 4. But during the entire time of the experiment, the temperature did not go lower than two degrees below zero and then for only a day or so at a time, and there were many fine bright days when it hardly reached freezing. The rainfall was light and few storms hindered in the least, and most of the time, the yards were in very good condition.

## RATIONS USED IN THE EXPERIMENT.

The following combinations of feeds were decided upon to be used at the beginning of the experiment; how long they should be continued without change to be goverened by the results obtained; as to how the steers would eat and fatten on them.

Ration I A.—Cottonseed, 12 pounds; cottonseed meal, 3 pounds; wheat straw, 10 pounds; prairie hay. 4 pounds

Ration II A.—Wheat meal, 11½ pounds; cottonseed meal, 3½ pounds; wheat straw, 10 pounds; prairie hay 4 pounds.

Ration III A.—Cottonseed, 12 pounds; wheat meal, 5 pounds; wheat straw, 10 pounds; prairie hay, 4 pounds.

Ration IV A.—Cottonseed meal, 10 pounds; wheat straw, 20 pounds (one-half of the straw to be cut and mixed with the meal as fed.)

Ration V A.—Cottonseed, 13 pounds; wheat straw, 10 pounds; prairie hay, 4 pounds.

These rations were to be fed to lots I, II, III, IV, and V, respectively. They were compounded as a day's feed for a steer weighing 1000 pounds, and the feeds in each ration were so combined with the idea of coming as near to furnishing the nutrients prescribed for such an animal in the recognized feeding standards as the feeds in the different rations would permit, and still keep the cost of the same at the minimum.

## DIGESTIBLE NUTRIENTS IN FEEDS OF AVERAGE QUALITY.

In calculating the rations to be used, the per cents of digestible nutrients in the various feeds were taken as given in table II. With the exception of prairie hay, which was taken from bulletin No. 81, Kansas Experiment Station, they were taken from Henry's "Feeds and Feeding."

### TABLE II.

DIGESTIBLE NUTRIENTS IN FEEDS.

| | Dry Matter in 100 Pounds | Digestible Nutrients in 100 lbs. of Feed. | | | Nutritive Ratio |
|---|---|---|---|---|---|
| | | Protein | Carbohydrates | Fats | |
| Cottonseed | 89.7 | 12.5 | 30. | 17.3 | 1: 5.7 |
| Cottonseed Meal | 91.8 | 37.2 | 16.9 | 12.2 | 1: 1.2 |
| Wheat | 89.5 | 10.2 | 69.2 | 1.7 | 1: 7.2 |
| Wheat Straw | 90.4 | .4 | 36.3 | .4 | 1:93.1 |
| *Prairie Hay | 85. | 3.5 | 41.8 | 1.4 | 1:12.9 |
| Alfalfa Hay | 91.6 | 11. | 39.6 | 1.2 | 1: 3.9 |

*Kan. B. 81.

## FEEDING STANDARD AND DIGESTIBLE NUTRIENTS IN RATIONS I A TO V A.

In Table III is given the amount of food nutrients required per day for a 1000 pound steer according to the recognized feeding standards, and the nutrients that the different rations I A to V A would have furnished according to Table II, if all of each ration had been eaten by the steers.

### TABLE III.

NUTRIENTS REQUIRED AS PER FEEDING STANDARDS AND THOSE CALCULATED (ACCORDING TO TABLE I.) AS FURNISHED IN RATIONS I A TO V A.

| | Pounds per Day per 1000 lb. Steer. | | | | | |
|---|---|---|---|---|---|---|
| | Dry Matter | Digestible | | | Nutritive Ratio | * Cost Cents |
| | | Protein | Carbohydrates | Fat | | |
| Standard First Period | 30 | 2.5 | 15.00 | 0.5 | 1 : 6.5 | |
| Standard Second Period | 30 | 3. | 14.50 | 0.7 | 1 : 5.4 | |
| Ration No. I A | 26 | 2.79 | 9.41 | 2.53 | 1 : 5.5 | 15 3-4 |
| Ration No. II A | 26 | 2.65 | 13.85 | 0.72 | 1 : 5.8 | 21 1-5 |
| Ration No. III A | 28 | 2.19 | 12.36 | 2.26 | 1 : 8.1 | 17 3-4 |
| Ration No. IV A | 27 | 3.8 | 8.95 | 1.30 | 1 : 3.2 | 16.5 |
| Ration No. V A | 24 | 1.8 | 9.20 | 2.34 | 1 : 8.2 | 12 3-4 |

* See Column I, Table I.

It should be noted wherein rations I A to V A differ radically from the standard. A pound above or below the protein given in the standard would be a wide variation, a difference of four pounds either way in the carbohydrates, and one pound too much of the fats, would be a wide variation. Variations as great as these will not enable the animal to utilize the food nutrients to the best advantage and in some cases, such variations may cause serious derangement in the animal system, as scouring, lack of appetite, etc. Compared with the nutrients in the standard, ration II A is very good and agrees very closely in every particular; in ration I A the most serious defect is that it contains about four times too much fat, 2.03 pounds above the standard, and is quite low in carbohydrates; ration III A has the same serious defect as ration I A in having far too much fat, and it is a little low in protein and carbohydrates; ration IV A is very high in protein and quite low in carbohydrates and quite high in fats; ration V A is irregular in every respect, being quite deficient in protein and carbohydrates and very high in fats. As has been stated these were the rations that were planned to be fed to lots I, II, III, IV and V respectively, but there was a doubt about getting the steers to eat all of some of the rations, and now the portions which were eaten and what changes had to be made should be noted.

### CHANGES IN RATIONS.

First, the preliminary feeding previous to the beginning of the experiment demonstrated that some alterations were necessary at once. The full amount, four pounds, of the prairie hay prescribed was fed and all eaten in the lots that received it. The prescribed amount of straw was not as well eaten, particularly by some of the lots of steers. Of the 10 pounds of straw in ration I A, not over seven-tenths was eaten at any time during periods I and II, and that amount for but one week, and for half of the time, not over four-tenths was eaten. With lot II it was much better, and for a week or two they ate more than the ten pounds of wheat straw and most of the time they ate more than three-quarters of the prescribed amount, but as with all the lots the amount varied from time to time. Lot III, for a very short time, ate about one-half of the ten pounds prescribed in ration III A, but during most of the time during periods I and II, they ate only two to three-tenths of the amount. In ration IV A it was found that the ten pounds of cut straw would be too much bulk to mix with a day's feed of grain, and the amount was reduced to four pounds which made the mixture of the grain and straw about right and was practically all eaten by the steers. As the ration was planned this would have left sixteen pounds of whole straw per steer per day. For about a week they ate a trifle over twelve pounds but the amount gradually fell off and for four-fifths of the time it ran above five pounds. Of the ten pounds in ration V A about half was usually eaten during periods I and II. In all rations from a fifth to a third more straw was fed than was eaten.

Some difficulty was experienced in getting some of the lots to eat the amounts of grain prescribed in their rations. Although the steers had been on grain for several weeks previous to the beginning of the experiment, it was found not advisable to give them the full amount of grain prescribed in rations I A to V A for several weeks and some of the lots never reached the amount contained there. Where the grain in the rations was composed of a mixture, the proportion started with was always the same until a change, noted later, was made at the end of the tenth week or second period. Up to this time lot I was never able to eat the fifteen pounds of grain prescribed in ration I A. The amount eaten was usually about two pounds too low. After getting on full feed, lot II was very well satisfied with the fifteen pounds of grain in ration II A but during the greater part of the experiment, a little less than the full amount was eaten. (In this ration as in the others, with the exception of lot V, the grain per 1000 pounds of live weight is referred to.) Lot III, up to the time the change in the ration was made, lacked one to two pounds of eating the seventeen pounds of grain prescribed in ration III. Lot IV ate without trouble the full amount (ten pounds) of cottonseed meal in ration IV A, and more than this at times towards the close of the experiment. In ration V A only about two-thirds of the prescribed thirteen pounds of cottonseed was eaten at any time during the entire experiment. The amount eaten per steer per day was very close to eight pounds most of the time, sometimes over and sometimes under. The steers refusing to eat the amounts of feed in the rations as planned in I A to V A reduced the nutrients available, and changed their relations more or less which fact is noted later by referring to Table V. With these alterations that might be said to have been made mostly by the steers themselves, the rations as planned were fed during periods I and II, or 70 days of the experiment.

At the close of the second period a change was made in the grain mixtures of lots I and III, and in the roughage of lot V. In ration I, the grain, that for periods I and II, rations I B and I C, had been twelve parts cottonseed and three parts cottonseed meal, was changed to eight parts and seven parts respectively, for period III, ration I D. In ration III, the grain, that for periods I and II, rations III B and III C, had been twelve parts cottonseed and five parts wheat meal, was changed to eight parts and nine parts respectively, for period III, ration III D. In ration V, the roughage, that for periods I and II, rations V B and V C, had been prairie hay and straw, was changed by the prairie hay being dropped at once and all the alfalfa the steers would eat gradually put in its place, for ration V D that was eaten during period III. The changes in the grain of lots I and III made it more appetizing but they did not eat any more grain per day than what they were eating before the changes; and per 1000 pounds weight they ate a little less. Lot I ate a little more straw, and III some less. The alfalfa was greatly relished by lot V and it was gradually raised in amount until they were eating about twenty pounds per day by the third week after the change. These changes were made for the reason that the steers in lots I, III and V were not making good gains on the former rations. This point is commented on fully later. Lot IV was making about the same gains as lots I and III, but no change was made in its ration as it was desired to ascertain what results could be obtained with such a ration for the entire feeding period, as a similar ration is quite commonly used by feeders in the south.

## EXPLANATION OF TABLES.

In order to get such data, as the feed eaten and nutrients furnished by same, gains made, cost of gain, and the net returns, for each lot of steers fed on the various rations during the different periods, in form for ready comparison, the following tables are given:

The grain and roughage eaten by the different lots during the different periods are given in Table IV. The feed eaten is calculated as the daily average per steer per 1000 pounds weight. The rations eaten during period I are designated B; those eaten during period II, C; those eaten during period III, D.

### TABLE IV.

GIVING FEED EATEN PER DAY DURING PERIODS I, II AND III, AND COST OF SAME.

| | POUNDS EATEN PER DAY PER STEER PER 1000 LBS. WEIGHT | | | | COST OF FEED ‖ |
|---|---|---|---|---|---|
| PERIOD I, 35 DAYS | Grain § Pounds | Wheat Straw Pounds | Prairie Hay * Pounds | Total Roughage Pounds | Cents |
| Ration No. 1 B | 10.23 | 6.10 | 3.82 | 9.92 | 11.1 |
| Ration No. 2 B | 10.81 | 9.90 | 3.85 | 13.75 | 16.2 |
| Ration No. 3 B | 11.92 | 4.82 | 3.83 | 8.65 | 12.3 |
| Ration No. 4 B | 9.24 | †11.96 | | 11.96 | 13.9 |
| Ration No. 5 B | 7.96 | 7.12 | 3.84 | 10.96 | 8.5 |
| PERIOD II, 35 DAYS | | | | | |
| Ration No. 1 C | 12.47 | 4.07 | 3.63 | 7.70 | 12.3 |
| Ration No. 2 C | 14.68 | 8.14 | 3.51 | 11.65 | 20.2 |
| Ration No. 3 C | 14.08 | 2.80 | 3.61 | 6.41 | 13.7 |
| Ration No. 4 C | 10.29 | †10 04 | | 10.04 | 14.9 |
| Ration No. 5 C | 7.76 | 5.93 | 3.78 | 9.71 | 8.1 |
| PERIOD III, 35 DAYS | | | | | |
| Ration No. 1 D‡ | 12.39 | 3.74 | 3.45 | 7.19 | 13.9 |
| Ration No. 2 D | 14.16 | 5.44 | 3.29 | 8.73 | 19.0 |
| Ration No. 3 D‡ | 13.07 | 3.10 | 3.40 | 6.50 | 14.3 |
| Ration No. 4 D | 11.29 | †7.91 | | 7.91 | 15.7 |
| Ration No. 5 D‡ | 7.03 | 1.97 | *15.38 | 17.35 | 16.0 |

*Alfalfa hay instead of prairie hay, Ration 5 D.
†Four pounds of this was eaten as cut straw mixed with grain.
‡Note change in ration, pages 13 and 14.
‖See Table I, column I, page 5.
§For character of grain see pages 10 and 15.

In order that the reader may have the facts in mind at this point, the following statements are repeated:

The grain ration of lot II consisted of eleven and one-half parts of wheat meal and three and one-half parts of cottonseed meal by weight, for all the period without change. The grain ration of lot I, for periods I and II, consisted of twelve parts of cottonseed and three parts of cottonseed meal by weight; for period III the grain consisted of eight parts cottonseed and seven parts cottonseed meal; the grain of lot III consisted of twelve parts cottonseed and five parts wheat meal during periods I and II; and eight parts cottonseed meal and nine parts wheat meal during period III; the grain of lot IV was cottonseed meal for all periods without change; the grain of lot V was cottonseed for all the periods without change .

In table V are given the food nutrients (calculated from Table II), contained in rations I to V, B, C and D that were eaten during periods I, II and III respectively, as given in Table IV. The rations in Table V are designated B, C, and D, to correspond with Table IV. In addition to these are given the nutrients as given in the feeding standards and the average daily gain per steer per lot for the different periods.

## TABLE V,

GIVING FOOD NUTRIENTS REQUIRED FOR FATTENING STEERS, ACCORDING TO FEEDING STANDARDS, AND THE FOOD NUTRIENTS EATEN DURING PERIODS I, II AND III, BY THE DIFFERENT LOTS OF STEERS.

| | POUNDS PER DAY FOR A 1000℔ STEER | | | | | Average Daily Gain Per Steer Pounds |
|---|---|---|---|---|---|---|
| | | DIGESTIBLE NUTRIENTS | | | | |
| | Dry Matter Pounds | Protein Pounds | Carbohydrates, lbs. | Fat Pounds | Nutritive Ratio | |
| Standard, 1st period | 30. | 2.5 | 15.0 | 0.5 | 1:6.5 | |
| Standard, 2nd period | 30. | 3.0 | 14.5 | 0.7 | 1:5.4 | |
| Standard, 3rd period | 26. | 2.7 | 15.0 | 0.7 | 1:6.2 | |
| 1ST 35 DAYS | | | | | | |
| Ration No. 1 B | 18. | 1.95 | 6.61 | 1.75 | 1:5.5 | 2.35 |
| Ration No. 2 B | 22. | 1.95 | 11.37 | .55 | 1:6.5 | 3.54 |
| Ration No. 3 B | 18. | 1.56 | 8.29 | 1.59 | 1:7.8 | 2.29 |
| Ration No. 4 B | 19. | 3.49 | 4.92 | 1.18 | 1:2.2 | 2.45 |
| Ration No. 5 B | 17. | 1.16 | 6.59 | 1.46 | 1:8.7 | 1.12 |
| 2ND 35 DAYS | | | | | | |
| Ration No. 1 C | 18. | 2.32 | 6.40 | 2.10 | 1:4.9 | .88 |
| Ration No. 2 C | 24. | 2.58 | 12.79 | .70 | 1:5.6 | 2.15 |
| Ration No. 3 C | 18. | 1.80 | 7.83 | 1.86 | 1:6.8 | 1.42 |
| Ration No. 4 C | 19. | 3.86 | 5.38 | 1.29 | 1:2.2 | 1.30 |
| Ration No. 5 C | 16. | 1.13 | 6.06 | 1.43 | 1:8.4 | .69 |
| 3RD 35 DAYS | | | | | | |
| Ration No. 1 D | 18. | 3.11 | 6.63 | 1.91 | 1:3.6 | 2.05 |
| Ration No. 2 D | 20. | 2.48 | 11.43 | .66 | 1:5.2 | 2.13 |
| Ration No. 3 D | 17. | 1.60 | 9.18 | 1.24 | 1:7.6 | 2.50 |
| Ration No. 4 D | 18. | 4.23 | 4.78 | 1.41 | 1:1.9 | 1.52 |
| Ration No. 5 D | 22. | 2.58 | 8.91 | 1.42 | 1:4.8 | 1.95 |

Table VI gives the average amount of grain, the average amount of roughage and the average amount of dry matter eaten for each pound of gain made by the steers; the average daily gain made per steer and the average cost of the feed eaten per pound of gain, for periods I, II and III, and the average of the above for periods I and II, and for I, II and III.

## TABLE VI,

### GIVING AVERAGE DAILY GAIN PER STEER, AVERAGE AMOUNT OF GRAIN, ROUGHAGE AND DRY MATTER EATEN PER POUND OF GAIN MADE BY THE STEERS, AND COST OF FEED EATEN PER POUND OF GAIN.

| | AM'T EATEN PER LB. OF GAIN | | | Average Daily Gain Per Steer Pounds | Average Cost of Feed Eaten Per Pound of Gain Cents * |
|---|---|---|---|---|---|
| PERIOD I, 35 DAYS | Grain † Pounds | Roughage Pounds | Total Dry Matter Pounds ‡ | | |
| Ration No. 1 B | 4.55 | 4.41 | 7.97 | 2.35 | 5.7 |
| Ration No. 2 B | 3.17 | 4.03 | 6.39 | 3.54 | 5.1 |
| Ration No. 3 B | 5.43 | 3.94 | 8.35 | 2.29 | 6.4 |
| Ration No. 4 B | 3.87 | 4.30 | 8 00 | 2.45 | 6.0 |
| Ration No. 5 B | 7.26 | 10.04 | 15.29 | 1.12 | 9.3 |
| PERIOD II, 35 DAYS | | | | | |
| Ration No. 1 C | 15.52 | 9.58 | 22.78 | .88 | 17.7 |
| Ration No. 2 C | 7.78 | 6.18 | 12.59 | 2.15 | 11.4 |
| Ration No. 3 C | 10.97 | 4.99 | 14.41 | 1.42 | 12.0 |
| Ration No. 4 C | 8.54 | 8.41 | 15.59 | 1.30 | 12.5 |
| Ration No. 5 C | 11.88 | 14.86 | 23.85 | .69 | 14.8 |
| AVERAGE FOR PERIODS I AND II, 70 DAYS | | | | | |
| Ration No. 1, B and C | 7 55 | 5.83 | 12.02 | 1.62 | 9.0 |
| Ration No. 2, B and C | 4.91 | 4.84 | 8.73 | 2.84 | 7.5 |
| Ration No. 3, B and C | 7.55 | 4.34 | 10.67 | 1.86 | 8.6 |
| Ration No. 4, B and C | 5.52 | 6.19 | 10.64 | 1.88 | 8.3 |
| Ration No. 5, B and C | 9.02 | 11.88 | 18.55 | .91 | 11.4 |
| PERIOD III, 35 DAYS | | | | | |
| Ration No. 1 D | 6.95 | 4.04 | 10.03 | 2.05 | 8.7 |
| Ration No. 2 D | 7.96 | 4.91 | 11.67 | 2.13 | 11.2 |
| Ration No. 3 D | 8.15 | 3.05 | 8.29 | 2.50 | 7.4 |
| Ration No. 4 D | 8.47 | 5.93 | 13.34 | 1.52 | 11.9 |
| Ration No. 5 D | 3.98 | 9.84 | 12.39 | 1.95 | 9.6 |
| AVERAGE OF PERIODS I, II AND III, 105 DAYS | | | | | |
| Rations No. 1, B, C, D | 7.32 | 5.13 | 11.25 | 1.77 | 8.8 |
| Rations No. 2, B, C, D | 5.75 | 4.86 | 9.54 | 2.62 | 8.5 |
| Rations No. 3, B, C, D | 7.01 | 3.82 | 9.71 | 2.07 | 8.1 |
| Rations No. 4, B, C, D | 6.37 | 6.09 | 11.42 | 1.76 | 9.3 |
| Rations No. 5, B, C, D | 6.05 | 10.67 | 15.36 | 1.25 | 10.5 |

*See Table II, Column II, for prices of feed used.
†See page 15 for character of grain.
‡As determined by analysis.

In Table VII is given the total gain made and the total cost of feed eaten by each lot of steers during the entire experiment, 105 days; and the selling price per hundred weight on the Kansas City market, and the net returns (amount sold for minus first cost of steers, cost of feed and expense of marketing, freight, yardage and commission), for each lot of five steers.

### TABLE VII.

GIVING TOTAL GAINS; COST OF FEED FOR THE ENTIRE EXPERIMENT; SELLING PRICE PER CWT., AND NET RETURNS FOR EACH LOT OF STEERS.

| | Total Gain per lot | ** Av. Weight per Steer | * Total Cost of Feed per lot | Selling Price of Steers per cwt | Net Returns of Steers per lot |
|---|---|---|---|---|---|
| Lot No. 1 | 927 | 1190.8 | $ 82 07 | $ 5 20 | $ 36 56 |
| Lot No. 2 | 1374 | 1252.2 | 117 05 | 5 60 | 39 62 |
| Lot No. 3 | 1088 | 1221.4 | 87 94 | 5 40 | 47 57 |
| Lot No. 4 | 923 | 1167.8 | 86 39 | 5 25 | 35 28 |
| Lot No. 5 | 659 | 1139.4 | 62 15 | 5 00 | 24 25 |

* See Table I, Column II, Page 5.
**Mar. 11, Last Wt. in Experiment.

## FACTORS TO BE CONSIDERED IN COMPARING FEEDING RESULTS.

Many interesting and instructive points are revealed by a careful study and comparison of the data in Tables III, IV, V, VI and VII. In using the data in these tables and making comparisons between lots and between periods as to the desirability and efficiency of the different rations a few fundamental facts should be borne in mind, namely

First; With the fattening steer, the daily gains become less as the fattening period advances, granting that the character of the feed in the rations is not changed and the other conditions are uniform and normal during the meantime. In other words the fattening steer will gain more during the second month than during the fourth month. An example of conditions, other than a change in the character of the ration that would alter the above statement, would be a case where the weather was more favorable during the fourth month than during the second.

Second; The number of pounds of a given ration required to produce a pound of gain on a fattening steer, will increase in amount as the fattening period advances and the steer increases in weight, granting as in the first case, that the other conditions and factors that affect the fattening steer, are normal and uniform throughout the time considered. For example the feed required to produce a pound of gain in the fourth month would be more than that required for the second month of the fattening period of the steer.

Third; The gain made by the fattening steer may be more, and the amount of feed or dry matter required to produce a pound of gain may be less, during the fourth month of the fattening period than during the second; if a change is made from the ration used during the second month or the early part of the fattening period, to a more suitable ration for the fourth month, or the latter part of the fattening period. By a more suitable ration is meant one that contains the nutrients nearer the normal amounts and proportions and furnished in palatable feeds. The normal amounts and proportions of nutrients can be considered to be those prescribed in the feeding standards.

Fourth; A ration that may be best, or give good results, for a portion of the fattening period of the steer may not without change give good or the best results for the entire fattening period. This may be the case even with what might be considered normal rations. A variety, and changes during the fattening period are desirable for several reasons and should be studied.

Fifth; As the fattening period advances the appetite of the steer becomes less vigorous and as he is usually fed, he eats less feed per day per 1000 pounds of his weight during the latter part of the feeding period than was the case during the early part. Particularly is this true if he is fed on the same ration without change during the fattening period, and more particularly if said ration differs widely from a normal ration or is unsuitable in some other respect.

Sixth; In the ration of the fattening steer, a certain bulk or volume is necessary for the best results. Usually a large part of this is furnished in the roughage, and if the roughage is unpalatable or fed in insufficient amounts, the grain and roughage will not be eaten in desirable proportions to obtain the proper volume or condition in the stomach. If the ration contains the most desirable proportion of grain to the roughage, the "dry matter" contained in the ration will not fall more than eight or ten pounds below the amount of dry matter prescribed in the feeding standards. This should be given close attention where the grain consists of meal of any kind.

Seventh; The largest gain in weight does not always cost the least per pound or enable the steer to return the largest net profit when marketed.

Eighth; The gain in weight that costs the least per pound does not necessarily mean the largest net profit on the fattened steer.

Ninth; Taken singly, the gains made by the steers, the feed required to produce a pound of gain, the market value of the cattle when fattened do not tell which ration has given the most desirable or economical results. These factors should be considered in conjunction in order to decide which ration was the most desirable for beef production.

Tenth: The cost of feeds varies greatly due to different seasons and in different localities, consequently the cost of a given ration and the gain produced by it, will vary quite widely from time to time due to this so it is well to have in mind or in view, the number of pounds of a given ration required to produce a pound of gain, and the total gain produced or the market condition in which it puts the steer.

Eleventh; The manure made daily by a fattening steer will contain fertilizing ingredients in such amounts that if commercial fertilizers were purchased to obtain them, they would cost from six to ten cents per day. The fertilizing ingredients, nitrogen, phosphoric acid, and potash, in the manure produced during the 105 days by the different lots of steers in this experiment, would have cost, if they were purchased in commercial fertilizers, as follows: Lot I, $47.52; lot II, $52.61; lot III, $37.37; lot IV, $60.60; lot V, $34.47. Averaging these results per day per steer, the following values in cents are obtained: Lot I, 9.05; lot II,10.02; lot III, 7.11; lot IV, 11.54; lot V, 6.56. (These results are obtained by assuming that three-fourths of the fertilizing ingredients in the feeds fed, pass through the steer into the manure, and valuing them at the usual market price of these ingredients per pound; nitrogen, 15 cents; phosphoric acid, 7 cents; potash, 4.5 cents.)

## REVIEW OF THE PALATABILITY OF THE RATIONS AND AMOUNTS EATEN.

Before comparing the results produced by the various rations with the gains made, grain eaten per pound of gain and cost, net returns, etc., the character of the feed in the rations and their effect on the appetite of the steers and the amount eaten, and the nutrients furnished by same, should be fully in the mind of the reader. The amount of grain and roughage eaten per steer per day by the different lots is summarized in Table IV. Quite full comment has been made on this subject on page 13, so little comment further is necessary here. At this time it is well to recall the previous statement, that in feeding the steers, the idea was to feed them all the grain they would eat without getting them off feed. This was not carried out with lot IV.

The grain of lots I, II and III had a tendency to scour the steers when they were fed an unlimited quantity of it and for this reason the amount of grain fed to these lots was limited, but at times the amount given would reach a point where the steers would leave a little. This would, as a rule, be followed by scouring.

Lot V would eat about so much of the cottonseed and leave the rest in the trough. During the entire experiment they showed no signs of scouring.

Lot IV would have eaten considerable more of the cottonseed meal, but the fact was in our mind that large quantities of cottonseed meal fed to steers , for instance all they want, fourteen to eighteen pounds per day, will after about sixty days' feeding produce other very detrimental effects on the steers, and for this reason the amount of cottonseed meal fed to lot IV was limited, and at no time during the experiment did they show any signs of scouring.

Here it is well to bear in mind that the straw was fed in unlimited quantities and the prairie hay was given in a regular stated amount of four pounds per day per steer, and that the hay was all eaten, and that most of the lots could not be said to have been on full feed before the third week of the experiment. With the exception of the straw, lots II and IV ate the rations practically as planned in II A and IV A, page 10, while the other lots consumed considerably less grain and but a small portion of the straw figured on in rations A, as is clearly shown in Table IV.

## THE FOOD NUTRIENTS IN THE RATIONS AS EATEN, COMPARED WITH THOSE IN THE STANDARDS.

A comparison of the nutrients furnished by the different rations as eaten with those prescribed in the standard, and in the rations that were planned to have been fed, affords an interesting study and valuable suggestions. Referring to Tables III and V it will be seen that the steers fed on rations II, B, C and D, were the only ones that got anywhere near the nutrients as prescribed in the standards; and that this lot, after getting on a full feed of grain, obtained the nutrients practically as contained in II A, the ration as planned, which corresponded very closely with the standard; falling a little low in the protein and carbohydrates. Judging by the feeding standard, ration II would be considered about perfect, and referring to the gains made and the feed required to produce same, given elsewhere, the results produced will be seen to be highly satisfactory. (See Table VI and VII, lot II.)

In rations IV, B, C and D, the carbohydrates are materially less, and the protein more than was planned for in ration IV A, which makes a still greater variation from the standard. Quite a portion of the straw in IV A being refused reduced the carbohydrates, and more cottonseed meal being eaten than was figured on there, increased the protein. The point sould be noticed, that more protein was eaten in ration IV, B, C and D than in any of the other rations, but the amount was only about thirty-three per cent above the standard in this respect, while the carbohydrates fall short about half and the fats are twice too high. The ration would be called a very highly nitrogenous ration and in most cases a wasteful and expensive one and not capable of producing maximum gains. (See Table VII, lot IV.)

The character of rations II and IV was not changed during the entire experiment, while at the end of period II, the changes given on page 13 were made in I, III and V. By referring to rations I, III and V, B and C in Table V, the excessive amount of fat in each of them is a very striking point, although the amount is not as much as was figured on in the A rations. Rather than eat the very excessive amount of fat in the A rations, the steers were willing to subsist upon a smaller amount of feed that did not furnish the other nutrients in sufficient quantity. Still the other nutrients did not lack to the degree that the fat was in excess. From the amounts given in the standards, the protein fell twenty-two per cent to sixty-two per cent short, the carbohydrates forty-four per cent to fifty-eight per cent short, while the fat was 104 per cent to 250 per cent too high. These figures are for periods I and II. The change to rations I D, III D and V D at the beginning of the third period enabled the steers to eat a larger amount of total nutrients without eating any more fat than they were eating in periods I and II, and with III D the amount of fat was materially reduced. By noting the gains made during period III over those of period II the beneficial effect of reducing the excessive proportion of fat can be seen. From the above it can be said to be unwise to figure on a ration for a fattening steer, that would contain over one and one-half pounds of fat per day and as a rule the maximum should be placed at one and one-quarter pounds. By comparing the gains made on I C and I D, and III C and III D, it seems as important not to have the fat run too high in the rations of fattening steers as it is not to have the protein too low. The change from I C to I D increased the protein from 2.43 pounds to 3.11 pounds, fifteen per cent above the standard, and decreased the fat from 2.10 pounds to 1.91 pounds, 173 per cent above the standard. The change from III C to III D decreased the protein from 1.80 pounds to 1.60 pounds, forty-one per cent below the standard, and decreased the fat from 1.86 pounds to 1.24 pounds, seventy-eight per cent above the standard. Nevertheless the gain on III D was 438 pounds, on I D, 360 pounds, per lot; III D lacking forty per cent in protein, thirty-nine per cent in carbohydrates and having seventy-eight per cent too much fat, gave much better gains than I D, having fifteen per cent too much protein, fifty-nine per cent too little carbohydrates and 173 per cent too much fat. On comparing the results produced by rations I, III and IV and V with the results produced on such a ration as II, that comes very close to the requirements of the standards, it will be seen that rations I, III, IV and V were not very efficient in producing gains. (See Tables VI and VII.)

The foregoing results demostrate the advisability of using the feeding standards and the tables giving the nutrients in the different feeds, as guides in compounding rations; also the need of more experimentation to determine the feeding value of certain feeds and in what combinations to feed them.

## DAILY GAINS MADE AND FEED REQUIRED PER POUND OF GAIN.

The feeder will probably take more interest in studying Tables VI and VII than he has with the foregoing. Referring to Table VI, it will be seen that ration II which consisted of cottonseed meal and wheat meal for grain, and wheat straw and prairie hay for roughage, produced very good gains throughout the experiment, 105 days, and the amount of feed or dry matter required to produce a pound of gain was very satisfactory. In these points this ration was quite superior to any of the others given in Table VI, with the exception of III D which is really not comparable with ration II D for reasons mentioned elsewhere. The results of ration IV, which consisted of cottonseed meal and wheat straw, are referred to next as it, as well as ration II, was fed throughout the experiment without change. For rations of this kind the gains are very good and they stand second to those of ration II in the averages of periods

I and II. While the gains are much smaller than those produced by a well balanced ration, as II, the steers were put in a fair marketable condition on the ration without injurious effect to the steers, and at a profit that will be noted later.

The gains produced on the other rations and likewise the pounds of feed required to produce a pound of gain varied much in the different periods. Ration I, B and C, that during periods I and II consisted of twelve parts of cottonseed and three parts of cottonseed meal for grain, and wheat straw and prairie hay for roughage, produced during period I the third best gains, 2.35 pounds daily per steer; fair results but much below those produced on a good ration. The same ration I C differing only in amount, produced but .88 of a pound per day per steer in the second period and dropped down next to the lowest gain produced by any of the other rations. The gains were so inferior that for period III, the ration was changed from the above to eight parts of cottonseed and seven parts cottonseed meal, retaining the same roughage as before, and during period III, the gains increased to 2.05 pounds per day per steer. The increase in the gains in the third period over those in the second is remarkable but just what results ration I D would have produced if it had been fed from the beginning of the experiment is a question that can be answered only by further experimenting.

Ration III, B and C, that contained twelve parts cottonseed and five parts wheat meal for grain, and wheat straw and prairie hay for roughage during periods I and II, produced slightly smaller gains during period I than were produced by ration I B given above, but during period II the gains produced by ration III C was considerably better than those produced by ration I C, and slightly better than those produced by ration IV C (cottonseed meal for grain) for the same period. Due to the very small gains made during the second period, ration III, as given above, was altered by changing the grain to eight parts cotonseed and nine parts wheat meal. This ration fed during period III, produced a large increase in the gain over those obtained in period II; and a very important point to notice is that gains made in period III were larger than the gains made during period I; on ration III B. As with ration I D, the question arises what would have been the results if III D had been fed during periods I and II. It should be noted that the ration III D produced better gain in period III than were produced on ration II D, but the conclusion must not be drawn that it is a better ration or even as good a one as ration II D,as the steers in the two lots at the beginning of period III were altogether in different conditions and not comparable.

Ration V, B and C, consisting of cottonseed for grain, and wheat straw and a limited quantity of prairie hay for roughage, gave very small gains, by far smaller than any of the other lots, during periods I and II and was considered a flat failure as a ration for fattening steers. By substituting for the limited amount of prairie hay, all the alfalfa the steers would eat in ration V D, fed during period III, a gain was produced that was larger than the total gain made during periods I and II on the ration without the alfalfa. The gains made on this ration V D in period III are not quite as good as can be obtained on corn and alfalfa for a like period but the ration may prove practical in many cases for fattening steers.

## TOTAL GAINS, HEALTH AND CONDITION OF STEERS.

By referring to Table VII it will be seen that for the 105 days, the entire time of the experiment, the lots of five steers each, that were fed the ration corresponding to their number, rank as follows in the total gains made: Lot II, first; lot III, second, falling below lot II by 346 pounds; lot I, third, falling below lot II 447 pounds; lot IV fourth, falling below lot II, by 450 pounds; Lot V fifth, falling below lot II by 715 pounds. The gains made by lot II were very fair but those made by the other lots were quite meager. During the experiment no serious break occurred in the health of the steers. Steer No. 50 in lot II had a swelling on one jaw for a time that resembled lumpy jaw but it did not interfere much with his eating or his health. It appeared December 7th, and was at its worst a few days later, and had disappeared within a week. While none of the lots had the scours seriously during the experiment, lot I was troubled during a portion of the last week of period II by two steers scouring, and the steers did not have time to recuperate after the scouring before the weighing for the close of the period was made, which partially accounts for the small gains made by lot I during period II. On an occasion or two in lots II and III a steer or two was affected with very light cases of scours but not at a critical time as in lot I. No scours appeared in lots IV or V. Lot IV gave every sign of perfect health with the exception that one steer in the lot was accustomed to vomiting at times. It did not seem to affect his appetite or health otherwise. From all appearances the steers in lot IV could have been continued for several weeks on the feed they were receiving without causing any detrimental rsults in their health. Aside from having a very dejected look nothing could be seen out of the way in the health of lot V.

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NOT—Table VII may be found on Page 19.

At the close of the experiment there was quite a difference in the finish or the degree to which the different lots were fattened. None of the lots could be said to be fully finished. While lots II and III were fairly well fattened for cattle of their class, they would be classed as short fed cattle, particularly lot III. Lots I and IV would be said to be only well warmed up as they were rough and bare. Lot V would be classed as nothing more than fleshy feeders and their quality made them appear quite rough and coarse.

### SELLING PRICE COMPARED WITH THE GAINS.

The lots were sold on the Kansas City market in the lots of five, just as they were fed and the buyer was requested to price each individual lot on its merit, and as if it were a carload. Table VII gives the selling price per hundred weight of the different lots which corresponds fairly well with the gains made by the different lots. Considering the first cost of the steers, $3.25 per hundred weight, and the total cost of the feed eaten by each lot, and the selling price it will be seen by Table VII that the steers in lot III returned $47.57 net; lot II, $39.62; lot I, $36.56; lot IV, $35.28; lot V, $24.25. In considering these net profits it should be borne in mind that the margin between the price of the feeder steer and the finished bullock is very wide in these cases, much wider than can be counted on as a rule. The prices of the feeds in another season or a price nearer normal for the feeders would make a marked difference in the net returns.

### RESULTS FROM PIGS FOLLOWING THE STEERS.

As has been stated, each lot of steers was followed by two shoats and the idea was carried out to make the pigs subsist to quite an extent upon the droppings, although they might not make the gains that would compare with well fed hogs. From the beginning of the experiment, November 26 to January 6 each lot of pigs was fed two pounds of wheat meal per day per pig. With this amount the pigs worked the droppings over very well but were quite hungry and made very little gain in weight. For the above reason the wheat meal was raised on January 6 to five pounds per day per pig and kept at this amount until February 5. On the change the gains were better, but still small, and the droppings were not worked over as well. For further results on a smaller amount of grain, the wheat meal was reduced on February 5 to two pounds per day per pig and the amount continued until February 19. This made the pigs look after the droppings closer but they were making very small gains so the wheat meal was raised again to five pounds per day per pig and the amount continued until the close of the experiment. For four days interval between the close of the experiment and the shipping, the pigs were given a liberal amount of feed. Table VIII gives the final weight of each lot of pigs, total gains made during the experiment, and grain eaten per lot and per pound of gain.

### TABLE VIII.

GIVING GAINS OF PIGS FOLLOWING STEERS, AND GRAIN FED PER LOT PER LB. OF GAIN.

| | Results per Lot of 2 Pigs each | | | | |
|---|---|---|---|---|---|
| | Lot No. 1 Pounds | Lot No. 2 Pounds | Lot No. 3 Pounds | Lot No. 4 Pounds | Lot No. 5 Pounds |
| Total Weight of Pigs Nov. 26 | 207 | 221 | 225 | 209 | 177 |
| Total Gain in Pounds | 183 | 150 | 160 | 163 | 200 |
| Daily Gain Pounds per Pig, average | .87 | .71 | .76 | .78 | .95 |
| Total Grain Fed, lbs. | 620 | 620 | 620 | 620 | 620 |
| Grain, lbs. Fed per Pound of Gain | 3.39 | 4.13 | 3.87 | 3.80 | 3.10 |

There was somewhat of a variation in the gains made by the different lots but how far it could be attributed to the character of the droppings of the different lots of steers is a question. At the close of the experiment the pigs were in a condition to be marketed as light hogs and were shipped with the steers to Kansas City and sold in one bunch at $6.15 per hundred weight. From Table VIII it will be seen that the amount of grain that was fed for each pound of gain is very low as compared with the amount of grain required to produce one pound of gain when pigs are fattened on a full grain ration fed from the trough. Considering only the grain fed to pigs, the gain cost considerably less than it sold for and with the very wide margin between the price of the pigs when put in the experiment and when taken out the profits on the pigs were remarkably good and added much to the net outcome of the steers. The fact should be noted that all the pigs lived, and part of them were behind steers that were fed cottonseed meal as grain.

## SHIPPING AND MARKETING THE STEERS.

The experiment closed on the morning of March 11, but in order to ship the steers on a stock train they had to be held until the morning of the 16th, on which date they were loaded on the cars about 4 o'clock a. m. They arrived at the Kansas City stock yards about 7 o'clock the next morning, the 17th, and were sold about 10:30 o'clock.

From the close of the experiment the feed was not changed in kind or amount until the morning of the 14th, two days before shipping. At this time the grain ration was reduced one-half, and in addition to the straw the steers were getting, they were given all the prairie hay they would eat. This was continued until the evening preceding the morning they were put on the cars. At noon on the 16th, sixteen hours before they were put on the cars, all water was shut away from them. On the evening of the 16th and in the night they were given all the grain they would eat and the following amounts were eaten: Lot I, eighty-one pounds; lot II, eighty-nine pounds; lot III, forty-seven pounds; lot IV, sixty-five pounds; lot V, fifty pounds. Lot V was fed the same kind of grain ration as lot III and lot V was given prairie hay. Towards midnight the steers were driven quietly and slowly to the railroad yards that are about a mile from the Station farm and loaded about 1 o'clock in the morning. A weight was made of each lot of steers on the morning of the 15th to use in determining the shrinkage of the steers in shipping. The per cent, shrinkage per lot, and the pounds shrinkage per steer, is given in Table X. The steers went through the shipping without scouring and made a very good fill, but not abnormal, and were in first class shape when sold. They were handled by the Evans-Snider-Buel Commission Co., who were very careful to see that all our wishes were carried out in dividing the steers in the lots as they were fed, and selling each lot on its merits. The different packers rendered valuable assistance by carefully looking over the small lots and pricing each one separately. The steers were purchased by the Ruddy Packing Co., who very kindly made a slaughter test with each lot and furnished the data in this line given in Table IX. The prices that the different lots sold for are given in Table VII and the financial statement on page 32.

## SLAUGHTER TEST.

The steers were slaughtered in lots of five as they were fed and sold and the results in Table IX obtained. In addition to the slaughter data given in that table the weights of each lot as sold in Kansas City and the last weight taken at the Station are given in order to show the shrinkage in shipping.

## TABLE IX.

GIVING SLAUGHTER TEST DATA AND SHRINKAGE OF STEERS IN SHIPPING.

| | Lot 1 | | Lot 2 | | Lot 3 | | Lot 4 | | Lot 5 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Total | Av. per Steer | Total | Av. per Steer | Total | Av. per Steer | Total | Av. per Steer | Total | Av. per Steer |
| Wt. at Stillwater Mar. 15 | 5969 | 1193.8 | 6257 | 1251.4 | 6092 | 1218.4 | 5871 | 1174.2 | 5784 | 1156.8 |
| Wt. at K. C. Mar. 17 | 5910 | 1182 | 6100 | 1220 | 6000 | 1200 | 5820 | 1164 | 5630 | 1126 |
| Shrinkage | 59 | 11.8 | 157 | 31.4 | 92 | 18.4 | 51 | 10.2 | 154 | 30.8 |
| Per Ct. Shrinkage | | .99 | | 2.5 | | 1.5 | | 8.6 | | 2.6 |
| Dressed Wt. of Carcasses | 3146 | 629 | 3512 | 702 | 3367 | 673 | 3300 | 660 | 3111 | 619 |
| Dressed Out per cent | | 53.2 | | 57.6 | | 56.1 | | 56.7 | | 55.3 |
| Wt. of Hides | 294 | | 314 | | 301 | | 307 | | 288 | |
| Per Ct. of Hides | | 5 | | 5.1 | | 5 | | 5.3 | | 5.1 |
| Wt. of Tallow | 160 | | 440 | | 365 | | 375 | | 235 | |
| Per Ct. Tallow | | 3 | | 7.2 | | 6.1 | | 6.4 | | 4.2 |

Attention is called to the small shrinkage in shipping made by the different lots. Since the shrinkage is figured in a very fair way it speaks well for the method of preparing the steers for shipping. The dressed carcasses were carefully examined by the expert dressed-beef men of the Ruddy Packing Co., and the following is their report on the carcasses in the cooler.

"With reference to the beef from these cattle will say that lot 5 killed off-color and when cut did not show up quite as bright as the other lots. Lot 2 proved to be the best covered and the best cutting lot of the 25 cattle and you will note the yield was better than the other lots. Lot 1 did not come up to our expectations. While they were decently covered and did not cut bad, they did not have the appearance of lots Nos. 2, 4 and 3, nor did they prove to yeld a comparative per cent. of beef. Lot No. 4 when dressed showed up satisfactory and cut well, while lot No. 3 appeared to be fair quality beef and a lot on which we could make no complaint. We expected, however, better results from them than the cattle in lot No. 4 but the latter lot when dressed show up better."

On close questioning they stated that there was nothing objectionable about the color of any of the lots further than noted. This is an important point to note in connection with lot 4. The average steer fattened on cottonseed meal in the ordinary way has a dirty yellow fat and is objected to very much by the packers.

### FINANCIAL OUTCOME OF THE FEEDING.

The reader should bear in mind that while it is important to know the profit or loss made on a given experiment, it is of more importance to study the gains produced by the different rations and the pounds of the feed required to produce 100 lbs. of gain and the market condition it will put the bullock in. The cost of feed and the relative price of the feeder and fat steer are very variable factors, and a ration that may have been fed at a profit one season may be fed at a loss the next. The relations of the profits between rations may be influenced likewise. In the financial statement is given the feed eaten by the different lots of steers and hogs, the cost of same, the first cost of the steers and pigs and their market value, and the cost of marketing.

### FINANCIAL STATEMENT,

Giving profit or net returns on the different lots of steers and pigs over the first cost of the steers and the cost of feed, and expense of marketing.

## LOT I—FIVE STEERS—TWO HOGS.

| | | |
|---|---|---|
| | Dr. | |
| To 5 Steers 5027 lbs. at $3.25 per cwt. | $ 163.38 | |
| Feed as follows: | | |
| To 4761.47 lbs. Cotton Seed at $16.28 per ton | 38.75 | |
| To 2025.36 lbs. Cotton Seed Meal at $25.72 per ton | 26.04 | |
| To 2760.05 lbs. Wheat Straw at $5.00 per ton | 6.90 | |
| To 2100.00 lbs. Prairie Hay at $9.98 per ton | 10.38 | |
| Freight Stillwater to K. C., commission, yardage, feed | 20.70 | |
| | | $266.15 |
| Expense of feed in holding last week | 4.61 | |
| Total Expenditures | | $270.76 |
| | Cr. | |
| By 5 Steers 5910 lbs. at $5.20 per cwt. | $307.32 | |
| Less | 270.76 | |
| Total profit per lot | | $36.56 |
| Average profit per Steer | | 7.31 |
| | Dr. | |
| To 2 Hogs 207 lbs. at $3.50 per cwt. | $7.24 | |
| To 620 lbs. Wheat Meal at $23.60 per ton | 7.32 | |
| Freight from Stillwater to K. C., commission and yardage | 1.50 | |
| | $16.06 | |
| Expense of feed during last week | .61 | |
| Total Expenditures | | $16.67 |
| | Cr. | |
| By 2 Hogs 408 lbs. at $6.15 per cwt | $25.09 | |
| Less | 16.67 | |
| Total profits per lot | $8.42 | |
| Average profit per hog | 4.21 | |
| Total profits per lot on hogs & steers | | $44.98 |

### LOT II—FIVE STEERS—TWO HOGS.

| | | |
|---|---|---|
| | Dr. | |
| To 5 Steers 4887 lbs. at $3.25 per cwt. | $158.83 | |
| Feed as follows: | | |
| To 1844.05 lbs. Cotton Seed Meal at $25.72 per ton | 23.71 | |
| To 6059.04 lbs. Wheat Meal at $23.60 per ton | 71.50 | |
| To 4580.77 lbs. Wheat Straw at $5.00 per ton | 11.46 | |
| To 2100.00 lbs. Prarie Hay at $9.89 per ton | 10.38 | |
| Freight Stillwater to K. C., commission, yardage, feed | 21.23 | |
| | | $297.11 |
| Expense of feed in holding last week | 4.87 | |
| Total Expenditures | | $301.98 |
| | Cr. | |
| By 5 steers 6100 lbs. at $5.60 per cwt. | $341.60 | |
| Less | 301.98 | |
| Total profit per lot | | $39.62 |
| Average profit per Steer | | 7.92 |
| | Dr. | |
| To 2 Hogs 221 lbs. at $3.50 per cwt. | $7.74 | |
| To 620 lbs. Wheat Meal at $23.60 per ton | 7.32 | |
| Freight Stillwater to K. C., commission | 1.39 | |
| | $16.45 | |
| Expense of feed during last week | .61 | |
| | $17.06 | |
| | Cr. | |
| By 2 Hogs 396 lbs. at $6.15 per cwt. | $24.35 | |
| Less | 17.06 | |
| Total profits per lot | | $7.29 |
| Average profit per Hog | | 3.65 |
| Total profit per lot on Hogs and Steers | | $46.91 |

### LOT III—FIVE STEERS—TWO HOGS.

| | | |
|---|---|---|
| | Dr. | |
| To 5 Steers 5019 lbs. at $3.25 per cwt. | $163.12 | |
| Feed as follows: | | |
| To Cotton Seed 4733.64 lbs. at $16.28 per ton | 38.53 | |
| To 2870.70 lbs. Wheat Meal at $23.60 per ton | 33.88 | |
| To 2060.08 lbs. Wheat Straw at $5.00 per ton | 5.15 | |
| To 2100.00 lbs. Prairie Hay at $9.89 per ton | 10.38 | |
| Freight Stillwater to K. C., commission, yardage, feed | 20.95 | |
| | | $272.01 |
| Expense of feed in holding last week | 4.42 | |
| Total Expenditures | | $276.43 |
| | Cr. | |
| By 5 Steers 6000 lbs. at $5.40 per cwt. | $324.00 | |
| Less | 276.43 | |
| Total profit per lot | | $47.57 |
| Average profit per steer | | 9.51 |
| | Dr. | |
| To 2 Hogs 225 lbs. at $3.50 per cwt | $7.87 | |
| To 620 lbs. Wheat Meal at $23.60 per ton | 7.32 | |
| Freight Stillwater to K. C., commission and yardage | 1.40 | |
| | | $16.59 |
| Expense of feed during last week | .61 | |
| | | $17.20 |
| | Cr. | |
| By 2 Hogs 399 lbs. at $6.15 per cwt. | $24.53 | |
| Less | 17.20 | |
| Total profits per lot | | $ 7.33 |
| Average profit per Hog | | 3.67 |
| Total profit per lot on Hogs and Steers | | 54.90 |

### LOT IV.—FIVE STEERS—TWO HOGS.

| | | |
|---|---|---|
| To 5 Steers 4916 lbs. at $3.25 per cwt. | $159.77 | |
| Feed as follows: | | |
| To 588.27 lbs. Cotton Seed Meal at $25.72 per Ton | 75.62 | |
| To 4311.09 lbs. Wheat Straw at $5.00 per ton | 10.78 | |
| Freight Stillwater to K. C., commisson, yardage, feed | 20.45 | |
| | | $266.62 |
| Expenses of feed in holding last week | 3.66 | |
| Total Expenditures | | $270.28 |
| | Cr. | |
| By 5 Steers 5820 lbs. at $5.25 per cwt. | $305.55 | |
| Less | 270.28 | |
| Total profit per lot | | $35.27 |
| Average profit per Steer | | 7.05 |
| | Dr. | |
| To 2 Hogs 209 lbs. at $3.50 per cwt. | $7.32 | |
| To 620 lbs. Wheat Meal at $23.60 per ton | 7.32 | |
| Freight Stillwater to K. C., commission and yardage | 1.41 | |
| | | $16.05 |
| Expense of holding last week | .61 | |
| | | $16.66 |
| | Cr. | |
| By 2 Hogs 402 lbs. at $6.15 per cwt. | $24.72 | |
| Less | 16.66 | |
| Total profits per lot | | 8.06 |
| Average profit per Hog | | 4.03 |
| Total profit per lot on Hogs and Steers | | $43.33 |

### LOT V—FIVE STEERS—TWO HOGS.

| | | |
|---|---|---|
| | Dr. | |
| To 5 Steers 5038 lbs. at $3.25 per cwt. | 163.74 | |
| Feed as follows: | | |
| To 4228.37 Cotton Seed at $16.28 per ton | 34.40 | |
| To 2760.31 lbs Wheat Straw at $5.00 per ton | 6.90 | |
| To 1400.00 lbs. Phairie Hay at $9.89 per ton | 6.92 | |
| To 2975 lbs. Alfalfa Hay at $14.00 per ton | 20.83 | |
| Freight Stillwater to K. C., commission, yardage, feed | 19.91 | |
| | | $252.70 |
| Expense of feed in holding last week | 4.53 | |
| Total Expenditures | | $ 257.23 |
| | Cr. | |
| By 5 Stees 5630 at $5.00 per cwt. | $281.50 | |
| Less | 257.23 | |
| Total profit per lot | | $24.27 |
| Average profit per steer | | 4.85 |
| | Dr. | |
| To 2 Hogs 177 lbs. at $3.50 per cwt. | $6.20 | |
| To 620 lbs. Wheat Meal at $23.60 per ton | 7.32 | |
| Freight Stillwater to K. C., commission and yardage | 1.30 | |
| | | $14.82 |
| Expense of holding last week | .61 | |
| | | $15.43 |
| | Cr. | |
| By 2 Hogs 367 lbs. at $6.15 per cwt. | $22.57 | |
| Less | 15.43 | |
| Total profit per lot | | 7.14 |
| Average profit per Hog | | $3.57 |
| Total profit per lot on Hogs and Steers | | $31.41 |

The value of the manure obtained can be considered to at least balance the labor bill in feeding steers and the interest on the investment. The freight rate was 28 cents per cwt. on the steers and 31 on the hogs. The commission for selling the steers was 50 cents, and the yardage 25 cents, per head. The hay was a little over eight cents per head on the steers. In considering the financial returns the fact should be kept well in mind that the conditions; as relating to price of feeds, feeding steers, and the fattened bullock; that existed during the winter of 1901-1902, were very unusual. The conditions were referred to, early in the bulletin. Much of the profit on the steers and hogs was due to the large advance obtained on the price of the finished animals over the ones put into the feed yard. Today the feeder steer is purchased with the expectation of getting an advance of 1-2 to 1 1-4 cents per pound on him when fattened. The margin between the feeders and the fattened steers used in this experiment ran from $1.75 to $2.35 per cwt. The superior degree to which Lot II was fattened gave them a market value of 20 cents per cwt. above the next best lot, Lot III but due to the more expensive ration of Lot II, Lot III gave the largest net returns. The returns for Lots I and III were very near the same. Even with the unsatisfactory ration of Lot V during periods I and II, they gave a net profit of $24.25 for the 105 days, and not considering the profit of $7.14 made on the hogs.

## GENERAL SUGGESTIONS.

Judging from this and other experiments carried on at the Oklahoma Experiment Station, and observations made elsewhere, it is suggested where cottonseed is to be used in the ration of cattle, that not more than eight pounds of it be fed per day as a maximum amount, and generally four to six pounds will prove more satisfactory. In order to use it in the ration of the fattening steer, it must be fed with other highly nutritious feeds; and preferably those belonging to the nitrogenous group as alfalfa or cowpeas. Also it is desirable to mix the cottonseed with some other grain.

If ground grains or meals or small grain as Kafir corn or wheat are being fed to cattle, more thorough mastication and better results will be obtained if a few pounds of cottonseed are mixed with these feeds although other feeds as cottonseed hulls, some kind of chaffed hay or straw may answer the purpose.

While many steers are fattened in the South on cottonseed meal and cottonseed hulls, there is no doubt but what, as a rule, much better gains would be procured and at a less cost, if some grain as corn, wheat, Kafir corn were mixed with the cottonseed meal and hulls, and it is a question if a little of some other roughage besides the hulls should not be used for the best and most economical results. In the experiment at this Station, steers were fattened successfully and economically on cottonseed meal and wheat straw by chaffing a portion of the straw and mixing it with the meal when fed, but very much larger gains were produced and much greater profit made on other steers fattened on a ration of 3 1-2 pounds of cottonseed meal and 11 1-2 pounds of wheat meal and a small amount of prairie hay and an unlimited amount of wheat straw. Again, as compared with the steers fattened on cottonseed meal and wheat straw, better gains and a greater profit were produced on other steers fattened on a ration in which cottonseed was mixed with the cottonseed meal. By mixing corn with the cottonseed meal similar results to those obtained with the wheat and cottonseed can be obtained but as a rule when the corn is used the profit will be greater as the corn will cost less than the wheat or cottonseed.

As related in the experiment in this bulletin, good gains were produced upon a grain ration of 11 1-2 pounds of wheat meal and 3 1-2 pounds of cottonseed meal and 4 pounds of prairie hay and an unlimited amount of wheat straw, but probably better results would have been obtained if some kind of chaffed hay or straw or cottonseed hulls had been mixed with the grain when fed. More prairie hay, or better still some alfalfa hay added to the roughage would have been very beneficial and probably economical.

Cottonseed and cottonseed meal are quite regular constituents in the grain fed to the herd of breeding cattle kept on the College Farm. The herd referred to includes bulls, cows and calves and numbers about thirty head. The addition of these feeds is found necessary for the most desirable and economical results. The rations for this stock are so planned that a mature cow will not as a rule get over two or three pounds of cottonseed meal, or three or four pounds of cottonseed, per day, and generally the amount does not reach the above. Corn or Kafir corn is always mixed with these feeds.

F. C. BURTIS,
Agriculturist.

## II—CHEMICAL STUDY OF THE EXPERIMENT.

### INTRODUCTION.

The discussion of the results of this experiment, from a feeder's standpoint (Part I), is based on average analyses and digestion coefficients which are available to feeders generally, except that actual figures for dry matter, as determined by analysis, were used. For the purpose of adding to the limited amount of available data as to the composition of some of the feeds used and of comparing the gains with the nutrients consumed by the different lots, chemical control of the experiment was maintained throughout. At the present stage of our investigations of this character, it was not practicable to make digestion trials with the different rations. Consideration of the digestibility of the different feeds has been omitted from the following brief summaries because of uncertainty as to the applicability of digestion coefficients, determined in the usual manner, to rations of this character being fed to fattening steers. Only the total nutrients were used in the calculations.

### SAMPLING THE FEEDS.

During the first period, a sample of the grain ration as fed to each lot was taken for each week. During the second and third periods, samples of the separate grain feeds were taken before mixing the grain rations. Total moisture was determined in each sample as brought to the laboratory and later the samples for each lot , or of each feed, for each period of five weeks were combined for analysis.

One sample of wheat straw, representing that fed uncut to all lots, was taken when the straw was weighed out. Air-dry moisture was determined and later, the samples for each period were combined for analysis. The prairie hay and alfalfa were handled in the same manner. The cut wheat straw fed to Lot IV was sampled for the determination of air-dry moisture only.

The refused grain was saved until the end of each period, weighed, and sampled for analysis. Refused roughage was collected daily, stored, and sampled at the end of each period, giving one sample for each lot for analysis.

The hay, straw, and refused roughage were cut fine when sampled and 1000 grams were taken for the determination of air-dry moisture and subsequent combination for complete analysis, except in the case of refused roughage which was analyzed as sampled.

## METHODS OF ANALYSIS.

The methods of the Association of Official Agricultural Chemists were, with minor exceptions, followed in making the analyses.

## COMPARISON OF ANALYSES.

In the following table the average of the analyses made in this experiment are given and on the next line under each feed is the average analysis which was used in Part I.

### TABLE X

ANALYSES MADE, COMPARED WITH AVERAGE ANALYSES.

| Source of Analysis | No. Analyses | Material | Water | Ash | Protein | Fiber | Nitrogen Free Extract | Ether Extract |
|---|---|---|---|---|---|---|---|---|
| Okla | 3 | Cottonseed Meal | 5.71 | 5.23 | 41.48 | 5.68 | 31.27 | 10.63 |
| "Feeds & Feeding" | 35 | COTTONSEED MEAL | 8.20 | 7.20 | 42.30 | 5.60 | 23.60 | 13.10 |
| Okla | 3 | Cottonseed | 9.07 | 4.49 | 13.92 | 32.72 | 24.92 | 14.88 |
| "Feeds & Feeding" | 5 | COTTONSEED | 10.30 | 3.50 | 18.40 | 23.20 | 24.70 | 19.90 |
| Okla | 2 | Wheat Meal | 9.86 | 1.52 | 14.14 | 2.85 | 69.75 | 1.88 |
| "Feeds & Feeding" | 310 | WHEAT MEAL | 10.50 | 1.80 | 11.90 | 1.80 | 71.90 | 2.10 |
| Okla | 5 | Wheat Straw | 11.07 | 7.87 | 4.59 | 38.96 | 35.72 | 1.79 |
| "Feeds & Feeding" | 7 | WHEAT STRAW | 9.60 | 4.20 | 3.40 | 38.10 | 43.40 | 1.30 |
| Okla | 3 | Prairie Hay | 11.03 | 6.39 | 4.72 | 33.31 | 42.41 | 2.14 |
| Kansas B. 103 | 1 | PRAIRIE HAY | 9.10 | 7.90 | 3.60 | 29.80 | 47.40 | 2·20 |
| Okla | 1 | Alfalfa Hay | 11.57 | 8.04 | 14.29 | 29.00 | 34.73 | 2.37 |
| "Feeds & Feeding" | 21 | ALFALFA HAY | 8.40 | 7.40 | 14.30 | 25.00 | 42.70 | 2.20 |

The variations from average analyses are marked in the nitrogen-free extract and ether extract of cottonseed meal and in the protein and ether extract of cottonseed. Wheat meal differs widely from the average in protein and the protein in the wheat straw used is also higher than the average. Prairie hay is such a variable product that differences are to be expected. Alfalfa hay agrees very closely with the average.

## SUMMARY OF FEEDING AND ANALYTICAL DATA.

In the following tables (XI to XIII) will be found summaries of the nutrients required to produce the gains which were obtained when the different rations were fed,and of the nutrients required to produce a pound of gain. The fodder analyses made in connection with the experiment are given in Table XIV.

While these results do not present sufficient data for the drawing of any conclusions, it appears from Table XIII that the usual digestion coefficients may not be applicable to rations of the sort fed in this experiment. The wide variations in the amounts of dry matter required to produce a pound of gain, and especially the large amount required in Period II in each case, seem to indicate that the cottonseed and cottonseed meal had some physiological effect which is not understood. There appear to to have been factors other than "digestibility" as the term is usually used. What these factors are and how they may be measured and controlled is an interesting problem.

JOHN FIELDS,
Chemist.

## TABLE XI.

GAINS: TOTAL FEED, DRY MATTER AND NUTRIENTS FED, REFUSED AND EATEN, lbs.

| | Total Weight | Dry Matter | Ash | Protein | Fiber | Nitrogen Free Extract | Ether Extract |
|---|---|---|---|---|---|---|---|
| **Ration I B.** | | | | | | | |
| Grain fed | 1938.00 | 1766.20 | 87.43 | 514.32 | 534.10 | 346.17 | 284.18 |
| Grain refused | 62.54 | 58.09 | 3.20 | 15.07 | 14.33 | 16.24 | 9.25 |
| Roughage fed | 2380.00 | 2061.50 | 166.65 | 105.15 | 825.18 | 915.38 | 49.14 |
| Roughage refused | 561.54 | 487.12 | 50.61 | 25.16 | 195.79 | 201.19 | 14.37 |
| Grain eaten | 1875.46 | 1708.11 | 84.23 | 499.25 | 519.77 | 329.93 | 274.93 |
| Roughage eaten | 1818.46 | 1574.38 | 116.04 | 79.99 | 629.39 | 714.19 | 34.77 |
| Total feed eaten | 3693.92 | 3282.49 | 200.27 | 579.24 | 1149.16 | 1044.12 | 309.70 |
| Gain | 412 | | | | | | |
| **Ration I C.** | | | | | | | |
| Grain fed | 2450.00 | 2243.71 | 116.81 | 462.49 | 545.16 | 732.35 | 386.90 |
| Grain refused | 43.63 | 39.95 | 2.53 | 8.09 | 9.91 | 11.98 | 7.44 |
| Roughage fed | 2030.00 | 1814.04 | 148.96 | 87.25 | 785.04 | 749.87 | 42.92 |
| Roughage refused | 554.44 | 486.54 | 40.27 | 17.71 | 221.74 | 193.67 | 13.15 |
| Grain eaten | 2406.37 | 2203.76 | 114.28 | 454.40 | 535.25 | 720.37 | 379.46 |
| Roughage eaten | 1485.56 | 1327.50 | 108.69 | 69.54 | 563.30 | 556.20 | 29.77 |
| Total feed eaten | 3891.93 | 3531.26 | 222.97 | 523.94 | 1098.55 | 1276.57 | 409.23 |
| Gain | 155 | | | | | | |
| **Ration I D.** | | | | | | | |
| Grain fed | 2505.00 | 2301.99 | 122.82 | 735.20 | 457.22 | 653.79 | 332.96 |
| Roughage fed | 1680.00 | 1509.09 | 116.41 | 81.29 | 662.19 | 623.90 | 25.30 |
| Roughage refused | 223.97 | 201.13 | 18.26 | 5.26 | 97.11 | 77.80 | 2.70 |
| Grain eaten | 2505.00 | 2301.99 | 122.82 | 735.20 | 457.22 | 653.79 | 332.96 |
| Roughage eaten | 1456.03 | 1307.96 | 98.15 | 76.03 | 565.08 | 546.10 | 22.60 |
| Total feed eaten | 3961.03 | 3609.95 | 220.97 | 811.23 | 1022.30 | 1199.89 | 355.56 |
| Gain | 360 | | | | | | |
| Feed for 105 days | 11546.88 | 10423.70 | 644.21 | 1914.41 | 3270.01 | 3520.58 | 1074.49 |
| Gain in 105 days | 927 | | | | | | |
| **Ration II B.** | | | | | | | |
| Grain fed | 1966.50 | 1792.39 | 45.89 | 418.88 | 63.45 | 1188.89 | 75.28 |
| Roughage fed | 2660.00 | 2308.82 | 187.79 | 117.70 | 930.30 | 1017.76 | 55.27 |
| Roughage refused | 159.84 | 138.69 | 17.84 | 6.66 | 52.64 | 57.92 | 3.63 |
| Grain eaten | 1966.50 | 1792.39 | 45.89 | 418.88 | 63.45 | 1188.89 | 75.28 |
| Roughage eaten | 2500.16 | 2170.13 | 169.95 | 111.04 | 877.66 | 959.84 | 51.64 |
| Total feed eaten | 4466.66 | 3962.52 | 215.84 | 529.92 | 941.11 | 2148.73 | 126.92 |
| Gain | 620 | | | | | | |
| **Ration II C.** | | | | | | | |
| Grain fed | 2945.00 | 2676.50 | 69.31 | 550.63 | 94.26 | 1866.24 | 96.06 |
| Grain refused | 18.41 | 16.73 | 0.43 | 3.39 | 0.65 | 11.57 | 0.69 |
| Roughage fed | 2800.00 | 2500.11 | 207.67 | 118.20 | 1098.27 | 1017.65 | 58.32 |
| Roughage refused | 475.43 | 424.60 | 36.43 | 19.73 | 188.71 | 168.01 | 11.72 |
| Grain eaten | 2926.59 | 2659.77 | 68.88 | 547.24 | 93.61 | 1854.67 | 95.37 |
| Roughage eaten | 2324.57 | 2075.51 | 171.24 | 98.47 | 909.56 | 849.64 | 46.60 |
| Total feed eaten | 5251.16 | 4735.28 | 240.12 | 645.71 | 1003.17 | 2704.31 | 141.97 |
| Gain | 376 | | | | | | |
| **Ration II D.** | | | | | | | |
| Grain fed | 3010.00 | 2739.08 | 72.69 | 676.19 | 113.55 | 1744.05 | 132.60 |
| Roughage fed | 2205.00 | 1986.13 | 155.68 | 107.01 | 886.88 | 805.83 | 30.73 |
| Roughage refused | 348.96 | 314.23 | 30.70 | 14.42 | 151.07 | 113.51 | 4.53 |
| Grain eaten | 3010.00 | 2739.08 | 72.69 | 676.19 | 113.55 | 1744.05 | 132.60 |
| Roughage eaten | 1856.04 | 1671.90 | 124.98 | 92.59 | 735.81 | 692.32 | 26.20 |
| Total feed eaten | 4866.04 | 4410.98 | 197.67 | 768.78 | 849.36 | 2436.37 | 158.80 |
| Gain | 378 | | | | | | |
| Feed for 105 days | 14583.86 | 13108.78 | 653.63 | 1944.41 | 2793.64 | 7289.41 | 427.69 |
| Gain in 105 days | 1374 | | | | | | |

## TABLE XI--CONTINUED.

| | Total Weight | Dry Matter | Ash | Protein | Fiber | Nitrogen Free Extract | Ether Extract |
|---|---|---|---|---|---|---|---|
| **Ration III B.** | | | | | | | |
| Grain fed (a) | 2220.90 | 2028.39 | 81.67 | 361.63 | 584.99 | 762.70 | 237.40 |
| Grain refused | 43.48 | 39.34 | 2.64 | 6.47 | 9.36 | 15.54 | 5.33 |
| Roughage fed | 2380.00 | 2064.59 | 166.90 | 105.29 | 826.41 | 916.58 | 49.21 |
| Roughage refused | 800.38 | 694.11 | 69.81 | 28.89 | 255.68 | 321.66 | 18.07 |
| Grain eaten | 2177.42 | 1989.05 | 79.03 | 355.16 | 575.63 | 747.16 | 232.07 |
| Roughage eaten | 1579.62 | 1370.28 | 97.09 | 76.40 | 570.73 | 594.92 | 31.14 |
| Total feed eaten | 3757.04 | 3359.33 | 176.12 | 431.56 | 1146.36 | 1342.08 | 263.21 |
| Gain | 401 | | | | | | |
| **Ration III C.** | | | | | | | |
| Grain fed | 2765.02 | 2508.90 | 102.80 | 381.13 | 540.58 | 1137.47 | 346.92 |
| Grain refused | 33.13 | 29.99 | 1.79 | 5.41 | 7.58 | 11.46 | 3.75 |
| Roughage fed | 1855.00 | 1658.11 | 135.62 | 80.22 | 713.84 | 689.01 | 39.42 |
| Roughage refused | 612.90 | 547.32 | 52.79 | 24.93 | 237.81 | 217.32 | 14.47 |
| Grain eaten | 2731.89 | 2478.91 | 101.01 | 375.72 | 533.00 | 1126.01 | 343.17 |
| Roughage eaten | 1242.10 | 1110.79 | 82.83 | 55.29 | 476.03 | 471.69 | 24.95 |
| Total feed eaten | 3973.99 | 3589.70 | 183.84 | 431.01 | 1009.03 | 1597.70 | 368.12 |
| Gain | 249 | | | | | | |
| **Ration III D.** | | | | | | | |
| Grain fed | 2695.04 | 2430.92 | 81.34 | 408.96 | 407.39 | 1299.04 | 234.19 |
| Roughage fed | 1680.00 | 1509.11 | 116.41 | 81.29 | 662.20 | 623.91 | 25.30 |
| Roughage refused | 341.64 | 306.87 | 43.29 | 9.05 | 127.45 | 119.27 | 7.81 |
| Grain eaten | 2695.04 | 2430.92 | 81.34 | 408.96 | 407.39 | 1299.04 | 234.19 |
| Roughage eaten | 1338.36 | 1202.24 | 73.12 | 72.24 | 534.75 | 504.64 | 17.49 |
| Total feed eaten | 4033.40 | 3633.16 | 154.46 | 481.20 | 942.14 | 1803.68 | 251.68 |
| Gain | 438 | | | | | | |
| Feed for 105 days | 11764.43 | 10582.19 | 514.42 | 1343.77 | 3097.53 | 4743.46 | 883.01 |
| Gain in 105 days | 1088 | | | | | | |
| **Ration IV B.** | | | | | | | |
| Grain fed | 1665.00 | 1568.50 | 86.58 | 672.26 | 96.15 | 526.39 | 187.12 |
| Grain refused | 6.16 | 6.16 | 0.34 | 2.64 | 0.38 | 2.07 | 0.73 |
| Roughage fed | 2450.00 | 2130.15 | 182.08 | 108.10 | 905.34 | 881.79 | 52.84 |
| Roughage refused | 303.03 | 260.08 | 36.92 | 12.13 | 99.19 | 108.23 | 3.61 |
| Grain eaten | 1658.84 | 1562.34 | 86.24 | 669.62 | 95.77 | 524.32 | 186.39 |
| Roughage eaten | 2146.97 | 1870.07 | 145.16 | 95.97 | 806.15 | 773.56 | 49.23 |
| Total feed eaten | 3805.81 | 3432.41 | 231.40 | 765.59 | 901.92 | 1297.88 | 235.62 |
| Gain | 429 | | | | | | |
| **Ration IV C.** | | | | | | | |
| Grain fed | 1972.50 | 1851.27 | 103.30 | 745.51 | 97.38 | 709.22 | 195.86 |
| Grain refused | 5.56 | 5.22 | 0.29 | 2.10 | 0.28 | 2.00 | 0.55 |
| Roughage fed | 2520.00 | 2246.61 | 201.12 | 110.23 | 996.02 | 887.97 | 51.27 |
| Roughage refused | 602.43 | 536.75 | 42.74 | 22.75 | 235.39 | 223.22 | 12.65 |
| Grain eaten | 1966.94 | 1846.05 | 103.01 | 743.41 | 97.10 | 707.22 | 195.31 |
| Roughage eaten | 1917.57 | 1709.86 | 158.38 | 87.48 | 760.63 | 664.75 | 38.62 |
| Total feed eaten | 3884.51 | 3555.91 | 261.39 | 830.89 | 857.73 | 1371.97 | 233.93 |
| Gain | 228 | | | | | | |
| **Ration IV D.** | | | | | | | |
| Grain fed | 2275.00 | 2133.40 | 118.19 | 1041.95 | 142.73 | 589.03 | 241.50 |
| Grain refused | 20.51 | 19.23 | 1.06 | 9.39 | 1.29 | 5.31 | 2.18 |
| Roughage fed | 2030.00 | 1846.11 | 151.98 | 99.54 | 869.52 | 704.09 | 20.98 |
| Roughage refused | 452.17 | 411.42 | 42.44 | 11.85 | 188.36 | 158.64 | 10.13 |
| Grain eaten | 2254.49 | 2114.17 | 117.13 | 1032.56 | 141.44 | 583.72 | 239.32 |
| Roughage eaten | 1577.83 | 1434.69 | 109.54 | 87.69 | 681.16 | 545.45 | 10.85 |
| Total feed eaten | 3832.32 | 3548.86 | 226.67 | 1120.25 | 822.60 | 1129.17 | 250.17 |
| Gain | 266 | | | | | | |
| Feed for 105 days | 11522.64 | 10537.18 | 719.46 | 2716.73 | 2582.25 | 3799.02 | 719.72 |
| Gain in 105 days | 923 | | | | | | |

(a) Ration I B was fed during the first week.

## TABLE XI--CONCLUDED.

| | Total Weight | Dry Matter | Ash | Protein | Fiber | Nitrogen Free Extract | Ether Extract |
|---|---|---|---|---|---|---|---|
| **Ration V B.** | | | | | | | |
| Grain fed | 1560.00 | 1404.53 | 63.91 | 193.68 | 659.99 | 307.31 | 179.64 |
| Grain refused | 129.87 | 116.84 | 9.22 | 18.46 | 37.89 | 35.09 | 16.18 |
| Roughage fed | 2450.00 | 2123.49 | 171.95 | 108.29 | 851.53 | 941.05 | 50.67 |
| Roughage refused | 470.59 | 400.63 | 61.56 | 18.75 | 142.90 | 170.65 | 6.77 |
| Grain eaten | 1430.13 | 1287.69 | 54.69 | 175.22 | 622.10 | 272.22 | 163.46 |
| Roughage eaten | 1979.41 | 1722.86 | 110.39 | 89.54 | 708.63 | 770.40 | 43.90 |
| Total feed eaten | 3409.54 | 3010.55 | 165.08 | 264.76 | 1330.73 | 1042.62 | 207.36 |
| Gain | 197 | | | | | | |
| **Ration V C.** | | | | | | | |
| Grain fed | 1575.00 | 1433.75 | 73.26 | 222.95 | 418.66 | 447.04 | 271.84 |
| Grain refused | 136.60 | 124.23 | 9.50 | 19.18 | 32.71 | 44.15 | 18.69 |
| Roughage fed | 2205.00 | 1970.00 | 162.30 | 94.30 | 856.24 | 810.74 | 46.42 |
| Roughage refused | 406.48 | 392.89 | 37.72 | 17.22 | 177.43 | 150.47 | 10.05 |
| Grain eaten | 1438.40 | 1309.52 | 63.76 | 203.77 | 385.95 | 402.89 | 253.15 |
| Roughage eaten | 1798.52 | 1577.11 | 124.58 | 77.08 | 678.81 | 660.27 | 36.37 |
| Total feed eaten | 3236.92 | 2886.63 | 188.34 | 280.85 | 1064.76 | 1063.16 | 289.52 |
| Gain | 121 | | | | | | |
| **Ration V D.** | | | | | | | |
| Grain fed | 1435.00 | 1295.84 | 66.74 | 214.85 | 412.46 | 377.35 | 224.44 |
| Grain refused | 75.16 | 67.76 | 7.58 | 11.49 | 19.46 | 18.10 | 11.13 |
| Roughage fed | 3780.00 | 3373.49 | 300.44 | 466.32 | 1210.99 | 1316.71 | 79.03 |
| Roughage refused | 422.62 | 377.01 | 61.08 | 13.74 | 141.48 | 151.91 | 8.80 |
| Grain eaten | 1359.84 | 1228.08 | 59.16 | 203.36 | 393.00 | 359.25 | 213.31 |
| Roughage eaten | 3357.38 | 2996.48 | 239.36 | 452.58 | 1069.51 | 1164.80 | 70.23 |
| Total feed eaten | 4717.22 | 4224.56 | 298.52 | 655.94 | 1462.51 | 1524.05 | 283.54 |
| Gain | 341 | | | | | | |
| Feed for 105 days | 11363.68 | 10121.74 | 651.94 | 1201.55 | 3858.00 | 3629.83 | 780.42 |
| Gain in 105 days | 659 | | | | | | |

## TABLE XII.

SUMMARY OF THE DATA GIVEN IN TABLE XI.

| | Total Weight | Dry Matter | Ash | Protein | Fiber | Nitrogen Free Extract | Ether Extract |
|---|---|---|---|---|---|---|---|
| **Lot I—Five steers.** | | | | | | | |
| Grain eaten .................... | 6786.83 | 6213.86 | 321.33 | 1688.85 | 1512.24 | 1704.09 | 987.35 |
| Roughage eaten ................ | 4760.05 | 4209.84 | 322.88 | 225.56 | 1757.77 | 1816.49 | 87.14 |
| Total feed eaten ........... | 11546.88 | 10423.70 | 644.21 | 1914.41 | 3270.01 | 3520.58 | 1074.49 |
| Total Gain ................. | 927 | | | | | | |
| **Lot II—Five Steers.** | | | | | | | |
| Grain eaten .................... | 7903.09 | 7191.24 | 187.46 | 1642.31 | 270.61 | 4787.61 | 303.25 |
| Roughage eaten ................ | 6680.77 | 5917.54 | 466.17 | 302.10 | 2523.03 | 2501.80 | 124.44 |
| Total feed eaten ........... | 14583.86 | 13108.78 | 653.63 | 1944.41 | 2793.64 | 7289.41 | 427.69 |
| Total Gain ................. | 1374 | | | | | | |
| **Lot III—Five Steers.** | | | | | | | |
| Grain eaten .................... | 7604.35 | 6898.88 | 261.38 | 1139.84 | 1516.02 | 3172.21 | 809.43 |
| Roughage eaten ................ | 4160.08 | 3683.31 | 253.04 | 203.93 | 1581.51 | 1571.25 | 73.58 |
| Total feed eaten ........... | 11764.43 | 10582.19 | 514.42 | 1343.77 | 3097.53 | 4743.46 | 883.01 |
| Total Gain ................. | 1088 | | | | | | |
| **Lot IV—Five Steers.** | | | | | | | |
| Grain eaten .................... | 5880.27 | 5522.56 | 306.38 | 2445.59 | 334.31 | 1815.26 | 621.02 |
| Roughage eaten ................ | 5642.37 | 5014.62 | 413.08 | 271.14 | 2247.94 | 1983.76 | 98.70 |
| Total feed eaten ........... | 11522.64 | 10537.18 | 719.46 | 2716.73 | 2582.25 | 3799.02 | 719.72 |
| Total Gain ................. | 923 | | | | | | |
| **Lot V—Five Steers.** | | | | | | | |
| Grain eaten .................... | 4228.37 | 3825.29 | 177.61 | 582.35 | 1401.05 | 1034.36 | 629.92 |
| Roughage eaten ................ | 7135.31 | 6296.45 | 474.33 | 619.20 | 2456.95 | 2595.47 | 150.50 |
| Total feed eaten ........... | 11363.68 | 10121.74 | 651.94 | 1201.95 | 3858.00 | 3629.83 | 780.42 |
| Total Gain ................. | 659 | | | | | | |

## TABLE XIII.

TOTAL FEED. DRY MATTER, AND NUTRIENTS REQUIRED PER POUND OF GAIN.

| | Total Weight | Dry Matter | Ash | Protein | Fiber | Nitrogen Free Extract | Ether Extract |
|---|---|---|---|---|---|---|---|
| Ration I B. .................... | 8.97 | 7.97 | 0.49 | 1.41 | 2.79 | 2.52 | 0.76 |
| Ration I C. ...................... | 25.11 | 22.78 | 1.44 | 3.38 | 7.09 | 8.23 | 2.64 |
| Ration I D. .................... | 11.00 | 10.03 | 0.61 | 2.25 | 2.84 | 3.34 | 0.99 |
| Average of I B, I C, and I D... | 14.69 | 13.59 | 0.85 | 2.35 | 4.24 | 4.69 | 1.46 |
| Ration II B. .................. | 7.20 | 6.39 | 0.34 | 0.85 | 1.52 | 3.48 | 0.20 |
| Ration II C .................. | 13.97 | 12.59 | 0.63 | 1.72 | 2.67 | 7.19 | 0.38 |
| Ration II D........ ... ........ | 12.87 | 11.67 | 0.52 | 2.03 | 2.25 | 6.45 | 0.42 |
| Average of II B, II C, & II D... | 11.35 | 10.22 | 0.50 | 1.53 | 2.15 | 5.71 | 0.33 |
| Ration III B. ................. | 9.37 | 8.38 | 0.44 | 1.08 | 2.86 | 3.34 | 0.66 |
| Ration III C. ................... | 15.96 | 14.41 | 0.74 | 1.73 | 4.05 | 6.41 | 1.48 |
| Ration III D. ................. | 9.21 | 8.29 | 0.35 | 1.10 | 2.15 | 4.10 | 0.59 |
| Average of III B, III C, & III D. | 11.51 | 10.36 | 0.51 | 1.30 | 3.02 | 4.62 | 0.91 |
| Ration IV B. ................... | 8.87 | 8.00 | 0.53 | 1.78 | 2.10 | 3.04 | 0.55 |
| Ration IV C. .................. | 17.04 | 15.60 | 1.14 | 3.64 | 3.75 | 6.05 | 1.02 |
| Ration IV D. ................... | 14.41 | 13.38 | 0.85 | 4.21 | 3.09 | 4.29 | 0.94 |
| Average of IV B, IV C. & IV D. | 13.44 | 12.33 | 0.84 | 3.21 | 3.98 | 4.46 | 0.84 |
| Ration V B. .................... | 17.31 | 15.23 | 0.83 | 1.34 | 6.70 | 5.31 | 1.05 |
| Ration V C. ................... | 26.75 | 23.85 | 1.56 | 2.32 | 8.80 | 8.78 | 2.39 |
| Ration V D. ................... | 14.12 | 12.39 | 0.87 | 1.92 | 4.29 | 4.48 | 0.83 |
| Average of V B, V C, & V D. | 19.39 | 17.16 | 1.09 | 1.86 | 6.60 | 6.19 | 1.42 |

## TABLE XIV.

### COMPOSITION OF FEEDING STUFFS AS SAMPLED.

A. B. McREYNOLDS, Analyst.

| Sample Number | Material | Pounds in One Hundred Pounds | | | | | |
|---|---|---|---|---|---|---|---|
| | | Water | Ash | Protein | Fiber | Nitrogen Free Extract | Ether Extract |
| 2964 | Cottonseed meal, Ration IV B | 5.41 | 5.22 | 40.54 | 5.80 | 31.75 | 11.28 |
| 3076 | Cottonseed meal, Rations I, II & IV, C | 5.92 | 5.25 | 37.89 | 4.95 | 36.04 | 9.95 |
| 3082 | Cottonseed meal, Rations I, II & IV, D | 5.79 | 5.22 | 46.01 | 6.30 | 26.01 | 10.67 |
| 2965 | Cottonseed, Ration V B | 9.43 | 4.12 | 12.49 | 42.56 | 19.82 | 11.58 |
| 3074 | Cottonseed, Rations I, III & V, C | 9.10 | 4.65 | 14.14 | 26.53 | 28.34 | 17.24 |
| 3080 | Cottonseed, Rations I, III & V, D | 8.69 | 4.70 | 15.14 | 29.06 | 26.59 | 15.82 |
| 3075 | Wheat meal, Rations II & III, C | 10.22 | 1.47 | 12.86 | 2.67 | 71.55 | 1.23 |
| 3081 | Wheat meal, Rations II & III, D, | 9.51 | 1.57 | 15.42 | 3.02 | 67.95 | 2.53 |
| 2966 | Wheat straw, Rations I to V, B | 13.94 | 7.36 | 4.37 | 36.58 | 35.62 | 2.13 |
| 3053 | Wheat straw, Ration IV, D | 10.15 | 8.00 | 4.41 | 38.48 | 37.29 | 1.67 |
| 3071 | Wheat straw, Ration IV, C | 10.82 | 8.90 | 5.29 | 36.48 | 36.39 | 2.12 |
| 3072 | Wheat straw, Rations I to V, C | 10.94 | 7.62 | 4.02 | 40.66 | 34.76 | 2.00 |
| 3077 | Wheat straw, Rations I to V, D | 9.51 | 7.46 | 4.88 | 42.62 | 34.50 | 1.03 |
| 2967 | Prairie hay, Rations I, II, III & V, B | 10.84 | 6.26 | 4.60 | 30.61 | 45.76 | 1.93 |
| 3073 | Prairie hay, Rations I, II, III & V, C | 10.29 | 6.78 | 4.82 | 34.80 | 40.98 | 2.33 |
| 3078 | Prairie hay, Rations I, II & III, D | 11.96 | 6.13 | 4.74 | 34.53 | 40.48 | 2.16 |
| 3079 | Alfalfa hay, Ration V, D | 11.57 | 8.04 | 14.29 | 29.00 | 34.73 | 2.37 |
| 2961 | Grain, Ration I B | 8.22 | 4.54 | 26.73 | 27.75 | 17.99 | 14.77 |
| 2962 | Grain, Ration II B | 8.25 | 2.35 | 21.44 | 3.25 | 60.86 | 3.85 |
| 2963 | Grain, Ration III B | 9.02 | 3.75 | 14.83 | 26.67 | 35.76 | 9.97 |
| 2938 | Refused grain, Ration I B | 10.63 | 4.93 | 23.19 | 22.04 | 24.98 | 14.23 |
| 2939 | Refused grain, Ration III B | 10.58 | 5.99 | 14.70 | 21.28 | 35.33 | 12.12 |
| 2941 | Refused grain, Ration IV B | 19.65 | 6.00 | 19.13 | 19.34 | 30.98 | 4.90 |
| 2940 | Refused grain, Ration V B | 9.43 | 7.15 | 14.31 | 29.37 | 27.20 | 12.54 |
| 3025 | Refused grain, Ration I C | 9.20 | 5.75 | 18.38 | 22.52 | 27.24 | 16.91 |
| 3026 | Refused grain, Ration II C | 9.57 | 2.31 | 18.32 | 3.53 | 62.53 | 3.74 |
| 3027 | Refused grain, Ration III C | 9.13 | 5.42 | 16.39 | 22.95 | 34.74 | 11.37 |
| 3028 | Refused grain, Ration IV C | 16.62 | 5.51 | 24.43 | 15.30 | 31.40 | 6.74 |
| 3029 | Refused grain, Ration V C | 16.06 | 6.42 | 12.96 | 22.10 | 29.83 | 12.63 |
| 3062 | Refused grain, Ration II D | 9.89 | 2.56 | 10.76 | 3.73 | 69.44 | 3.62 |
| 3063 | Refused grain, Ration IV D | 12.21 | 6.41 | 33.20 | 12.14 | 27.42 | 8.59 |
| 3064 | Refused grain, Ration V D | 16.34 | 9.36 | 14.19 | 24.02 | 22.35 | 13.74 |
| 2930 | Refused roughage, Ration I B | 14.24 | 8.91 | 4.43 | 34.47 | 35.42 | 2.53 |
| 2931 | Refused roughage, Ration II B | 10.23 | 11.55 | 4.31 | 34.07 | 37.49 | 2.35 |
| 2932 | Refused roughage, Ration III B | 12.80 | 8.77 | 3.63 | 32.12 | 40.41 | 2.27 |
| 2933 | Refused roughage, Ration IV B | 16.29 | 12.06 | 3.89 | 31.79 | 34.84 | 1.13 |
| 2934 | Refused roughage, Ration V B | 15.39 | 13.00 | 3.96 | 30.18 | 36.04 | 1.43 |
| 3019 | Refused roughage, Ration I C | 12.65 | 7.23 | 3.18 | 39.81 | 34.77 | 2.36 |
| 3020 | Refused roughage, Ration II C | 12.00 | 7.55 | 4.09 | 39.11 | 34.82 | 2.43 |
| 3021 | Refused roughage, Ration III C | 13.74 | 8.32 | 3.93 | 37.48 | 34.25 | 2.28 |
| 3022 | Refused roughage, Ration IV C | 12.94 | 6.92 | 3.68 | 38.20 | 36.21 | 2.05 |
| 3023 | Refused roughage, Ration V C | 12.40 | 8.41 | 3.84 | 39.56 | 33.55 | 2.24 |
| 3065 | Refused roughage, Ration I D | 11.98 | 7.99 | 2.30 | 42.50 | 34.05 | 1.18 |
| 3066 | Refused roughage, Ration II D | 13.91 | 8.41 | 3.95 | 41.39 | 31.10 | 1.24 |
| 3067 | Refused roughage, Ration III D | 11.18 | 12.53 | 2.62 | 36.89 | 34.52 | 2.26 |
| 3068 | Refused roughage, Ration IV D | 12.65 | 9.06 | 2.46 | 39.96 | 33.69 | 2.18 |
| 3069 | Refused roughage, Ration V D | 12.22 | 14.22 | 3.20 | 32.94 | 35.37 | 2.05 |

# BULLETIN NO. 59.

Reprints from Bulletins No. 47, 50, and 52, and Annual Reports, 8 to 11, will be issued in September, 1903. This bulletin will contain nothing which, in some form or other, has not been sent to all of the addresses on the station mailing list and it will be sent only in response to direct request.

Address all communications to

EXPERIMENT STATION,
Stillwater, Okla.

# Oklahoma Agricultural Experiment Station.

## BULLETIN No. 59.

SEPTEMBER, 1903.

# REPRINTS

FROM

BULLETINS No. 47, 50 AND 52, AND
ANNUAL REPORTS 8 TO 11.

Bulletins of this Station are Sent Free to Residents of the Territory on Request.

STILLWATER, OKLAHOMA.

# Oklahoma Agricultural and Mechanical College

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**VISITORS ARE CORDIALLY WELCOMED AT ALL TIMES.**

The publications of the Station are sent free to residents of the Territory on request. All communications should be addressed, not to individuals or departments, but to the

EXPERIMENT STATION, Stillwater, Oklahoma.

# Reprints from Bulletins and Reports.

## INTRODUCTION.

The many thousands of new settlers in western and southwestern Oklahoma naturally look to the Experiment Station for information which will be of service to them in developing farms in a climate with which they are unacquainted. Many of the publications of the Station were designed to answer questions which new settlers ask, but the demand for bulletins and reports has been such that but few are left. An effort was made to secure a small appropriation from the legislature for the purpose of reprinting the reports for which the demand was greatest but it failed of success.

The need has been such however, that a partial reprint is absolutely essential and this is presented in the following pages. This bulletin contains nothing which, in some form or other, has not been sent to all of the addresses on the mailing list, and it will be sent only in response to a direct request or in reply to inquiries which are answered by articles in it.

Those who receive this bulletin and other publications of the Station are urged to preserve them for future reference and to advise the Station of change of address or failure to receive bulletins as issued.

JOHN FIELDS.
Director.

# Reprints From Bulletins.

## REPORTS OF WHEAT RAISERS.*

Through the kindness of the millers of the territory the Station secured the names of several successful wheat growers in each county who have furnished a statement of the methods which they follow on a large scale and the results which they have secured.

The reports cover a wide range of soil and climatic conditions and their uniformity is but another proof that good methods of farming will bring success in every part of Oklahoma. The chief points of uniformity of practice are:

1. Plow early and deep and work the soil well before seeding.

2. Complete the seeding before October 15.

3. Hard wheats as a rule are preferred in the western counties and on the uplands. Soft wheats are grown in the eastern counties.

4. Rotation is generally preferred to continuous culture of wheat and the beneficial effect of manure is mentioned in many cases.

Losses from insect ravages have been slight, but rust has been troublesome, especially on late wheat. The grain louse which attracted attention early in the season is mentioned as probably having caused loss in only one case. Grading up of seed wheat by using the fanning mill is recommended as profitable.

The majority of wheat raisers reporting pasture wheat when the conditions are suitable and find it profitable. Early sown wheat that is growing vigorously is said to be benefitted by proper pasturing and the advantage of the succulent feed during the winter is large.

JOHN FIELDS.

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*From Bulletin No. 47, September, 1900.

## EXPERIMENTS WITH WHEAT 1900.*

### SUMMARY.

I. The wheat season of 1899-1900 was quite a favorable one, and large yields were the rule on well tilled land. A dry fall and rust in the spring were the only drawbacks.

II. Wheat on July plowing yielded 7.84 bushels per acre more than wheat on August plowing; and 16 bushels more than on September plowing.

III. The grain on the early plowing was of a much better quality than on the late.

IV. The plowing and preparing of the early plowed plats was much less expensive than the August or the September plowing.

V. Results of trials at this station in former seasons agree in general with II, III and IV.

VI. July plowing that had been well worked down, retained over twice the amount of moisture that unplowed ground did during a very dry August and September, and twenty-four days of October.

VII. On the July plowing at no time during this drouth, of which there was a period of sixty days in which less than an inch of rain fell, was the moisture content of the soil too low to germinate the seed, nor did the crop suffer.

VIII. Moisture equal to an inch and a half of rain was lost in a few days from unplowed ground in August and September while there was a very small loss from the early plowed ground.

IX. Land, plowed in August, while the ground was hard and dry but worked down at several successive intervals with the aid of light showers, retained more moisture and carried the wheat through a severe drouth much better than the September plowed ground did.

X. Wheat seeded September 15, yielded two bushels more per acre than wheat seeded October 18, and thirteen and one-third bushels more than wheat seeded November 15.

XI. The wheat from the late seeding weighed seven pounds less per bushel than the early or medium seeding.

XII. In six former trials at this station, the November seedings ranged in yields from 1 to 13 bushels per acre; the October seeding, 4 to 30 bushels; the September seeding 15 to 49 bushels per acre.

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*From Bulletin No. 47, September, 1900.

XIII. In 1898-'99 wheat on land that received an application of 15 1-2 tons of stable manure per acre yielded six bushels more than double the yield on unmanured land.

XIV. In 1899-'00, wheat on the same manured land that had received an additional 11 tons of stable manure per acre yielded twice as much as the same unmanured land.

XV. The majority of the following varieties have been grown on the station farm for six years and can be recommended:—

SOFT, SMOOTH WHEATS.

Early Red Clawson, Fultz, German Emperor.

SOFT, BEARDED WHEATS.

Fulcaster, Missouri Blue Stem, New Red Wonder.

HARD SMOOTH WHEATS.

Red Russian, Oregon Red.

HARD, BEARDED WHEATS.

Sibley's New Golden, Turkey, Eversaw.

XVI. In 1899-'00, the yield of seventeen varieties averaged forty bushels per acre. Sibley's New Golden gave the largest yield, 44.5 bushels. Big English the smallest, 37.7 bushels per acre.

XVII. In the averages for six years, '93, '96, '97, '98, '99 and 1900 Sibley's New Golden stood first with an average yield of 29.2 bushels, and Big English last with a yield of 26.3 bushels per acre. Several other varieties were only a half bushel below Sibley's New Golden.

F. C. BURTIS.

J. G. KERR.

## MANURING THE SOIL.*

### SUMMARY.

Without going into detail as to the various considerations that may affect the results of manuring, at the present stage of our agricultural practice, the chief points to be observed in manuring are:

1. To manure the soil. Use all of the manure produced, prevent losses by washing away, quit burning straw, haul manure onto the fields, somewhere, sometime, somehow.
2. Manure the highest and poorest spots, give a good application at one time—from fifteen to twenty two-horse loads—and manure another place next time.
3. Manure with reference to the time of rainfall, to the next crop which is to be grown, and to the other work which must be done. Late fall and winter, when other work is not pressing, is a good time. Light top-dressings may be applied to wheat in the fall.
4. Growing crops for green manuring alone is not the most profitable method. Pasture them and plow under the remainder when about to mature. This applies chiefly to cow-peas. If sorghum is to be plowed under, it should be while the stalks are green and juicy so that they will decay quickly.

### INTRODUCTION.

The tendency everywhere in cultivating new soil has been to pay but little or no attention to the conservation and improvement of fertility. It is customary to refer to the fertility of new soils as "limitless unbounded and inexhaustible." Enthusiasts speak of the vast natural fertility of the soils and many who till the soil come to believe what they hear and give no heed to facts and the teachings of experience. This bulletin is issued in the hope that it may call to mind the really great opportunities for soil improvement possessed by Oklahoma farmers, and to partially clear away some of the difficulties that have appeared in the way of the use of farm manures.

### SOIL FERTILITY.

By soil fertility is meant, in a general way, its productiveness—its ability to produce a paying crop. Variations in the degree of fertility produce variations in the crops produced. Soil fertility depends upon three things:

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*Bulletin No 50. April, 1901.

1. The supply of moisture. Soils may be either too wet or too dry to produce a crop. They may be too hard or too loose, too coarse or too fine, and thus unable to retain sufficient moisture for crop production.

2. The mechanical condition. Texture, ease of working, tilth, cold, warm, are general terms referring to mechanical condition. The available supply of moisture is greatly affected by the mechanical condition of the soil.

3. The supply of plant food. By this is meant the chemical elements which are removed from the soil by plants and which must be present in the soil for crops to be grown and matured. Nitrogen, potash and phosphoric acid are the principal substances constituting plant food.

It is not the purpose of this bulletin to argue for the practice of manuring and to present a case in its defense. It is a fact that the aplication of manure to the soil is essential to continued, successful crop production, and those who dispute this fundamental principle as a principle, will find nothing of interest in what follows.

The application of manure, on the other hand, is a matter that should be investigated by every farmer and results that seem peculiar are often produced and are difficult of explanation.

## MANURING.

Under this general head are two sub-divisions:

1. The use of manure produced by animals and of refuse material such as straw, corn-stalks and the like.

2. Green manuring, or plowing under of all or part of a crop grown either solely for this purpose or in part for pasture.

The effect of the application of manure of any sort to the soil is to modify the supply of plant food, the mechanical condition, and the capacity for holding moisture. In practically all cases, the supply of plant-food is increased and a larger amount of it is placed at the disposal of succeeding crops. The mechanical condition, and consequently the capacity of the soil for water, is altered. For a time, until the soil settles and rains fill it with moisture after plowing, the effect may be harmful. After this condition is met, the results are usually beneficial

It is upon this point that the profitable manuring of Oklahoma soils hinges. The time of application in reference to the periods of ample rain-fall and to cultural methods determines whether or not beneficial results will be secured the first season. And since in farm operations, immediate results largely determine opinions of methods, it is thought by some that manuring is not profitable.

### EXPERIENCE OF FARMERS.

Among the questions included in an inquiry concerning the experience of farmers in the raising of wheat was the following: "What has been the result of manuring wheat ground?" To this inquiry 52 out of 118 reported trials with manure, thus implying that the other 66 had not tried it on wheat land. Six of the 52 reported unfavorable results from using manure on wheat.

The following are the condensed statements of those reporting adversely:

"Manured ground grows too much straw; not as good." "Bad results." "I think the land better for wheat without manure while it is new." "Heavy manuring has not proven a success here (Cleveland County) causing too rank straw and, in nearly every instance, late maturing and rust." "Manure on fresh land causes wheat to fall and rust." "It makes too much straw and does not fill."

The following are the condensed statements of those who have good results from using manure on wheat:

"Results better in second year; too much straw the first." "Good results from manure." "Good results from manuring." "Manuring light after wheat is sowed has given best results." "Sometimes it does not do well to manure too heavy." "Light manuring is good, heavy makes the wheat fall." "Heavy manuring makes too much straw." "Have manured some hard spots with good results." "Good results." "Good results." "Will increase yield one-half if proper amount is used." "Have manured a few patches with good results." "Light top-dressing with stable manure increased yield." "It makes a large increase in the crop." "Manured three acres last year and think wheat was two bushels better on it." "Good results; would not manure too heavy." "Manured thin land with fifty per cent increase in yield." "Good results." "Better yield " "Manure is all right if not too heavy." "On hard land it is all right." "Manuring is all right but there is not enough of it done." "Good results." "Tried small area, great success." "Very good results." "Good results." "Good results." "I have only this to say of manure—that it is the best work that I do to my wheat." "Good results." "You can't get too much. Head the wheat high and let all the litter on the ground to turn under." "Good results." "Think manuring of some kind very essential to invigorate the wheat plant." "Fresh stable manure and ashes, either from wood or straw, have paid largely for their application." "Increases the yield one-fourth." "With good results by top-dressing and working in with harrow and disk." "Manuring will increase yield one-fourth." "Top-dressing increased yields one-third, results of plowing under depend on supply of moisture. Manured ground ripens wheat earlier." "Good results." "Where manured, I get one-third more." "It pays to manure." "Paid well." "Good on land manured and plowed early." "Good results." "Farmers will have to manure their land to make wheat profitable." "Fine results." "Use all I can get with gratifying results."

When variations in seasons and soils and the rainfall and temperature of the wheat seeding season are considered, it is remarkable that the results of practical experience so strongly favor the application of manure to wheat lands. The report, "Top-dressing increased yields one-third, results of plowing under depend on supply of moisture," states the case exactly. In seasons where there is an abundant summer rainfall, manure plowed under will decay and settle down. On the other hand, in dry seasons, and especially if the soil is not well cultivated soon after plowing, manure which is plowed under will keep the soil open and make it dry out easily. The seed then goes into a dry soil, germinates poorly giving a thin stand, and starts off the wheat in a weakened condition.

This makes the manuring of land sown continuously to wheat difficult, and in such cases, it would appear that a top-dressing, well worked into the surface of the soil, would be the best and safest practice.

### RESULTS AT THE STATION.

The following table taken from bulletin No. 47, of this Station, is inserted, being of interest in this connection. An acre has been sown continuously to wheat since 1892. During the first six years no manure was applied. In the summer of 1898, 15,720 pounds of stable manure were applied to the south half of the acre and in 1899, another application of 11,350 pounds of well-rotted stable manure was put on. Both halves of the acre were treated exactly alike in all other respects. The yields for the last four years were as follows:

WHEAT, HALF ACRE PLATS.

| YEAR | Plat No. | Yield Par Acre | | Treatment |
|---|---|---|---|---|
| | | Grain Bu. | Straw Tons | |
| 1896-97 | 1 | 17.8 | 1.13 | Unmanured |
| | 2 | 17.9 | 1·14 | Unmanured |
| 1897-98 | 1 | 7.0 | .57 | Unmanured |
| | 2 | 7.5 | .66 | Unmanured |
| 1898-99 | 1 | 30.6 | 1.65 | Manured |
| | 2 | 12 0 | .68 | Unmanured |
| 1899-00 | 1 | 36.8 | 2.50 | Manured |
| | 2 | 18.1 | 1.17 | Unmanured |

In each case where manure was applied, the land was plowed in July and kept well worked until seeding time. Figured on a cash basis with wheat at fifty cents per bushel, thirteen and one-half tons of manure produced an increased yield of wheat amounting to a little more than eighteen and one-half bushels worth $9.25. The residual effect on the soil was such that no manure was applied last fall and it is safe to assume that less than one-half of the benefit from the use of the manure has yet been realized.

The results of manuring wheat land have been discussed rather fully for the reason that the use of manure on wheat presents peculiar difficulties and possibilities of loss during the first season.

### MANURING AND CROP ROTATION.

When a succession of crops is grown, the problem of manuring the soil is much simpler than when wheat is the sole crop. Greater opportunities are afforded for choice in the matter of time of application of manure, and there is less possibility of loss because of the drying of the soil. There is practically no danger of loss by leaching when manure is applied in the winter in this climate, and the soil is usually sufficiently dry so that loads may be readily drawn through the fields. It is thus possible to put manure on land that is to be used for corn, cotton, Kafir corn, castor beans, and other spring crops. If the land is plowed early, the spring and early summer rains will settle the soil and lessen the danger which exists when manure is applied in a dry time of the year. Another factor favoring winter manuring is the more comfortable working temperature at that time of the year and the lack of urgent work that must be done.

As the use of manure becomes more general, discussions as to the best time to apply manure will arise and experiments to test this point will be made. At present, however, the great need is that farmers generally should save and use the manure produced on the farms and put it on the soil. It now matters little when or how—the one great thing is to form the habit of using the manure that is produced in the towns and on the farms.

### SOURCES OF MANURE.

As previously indicated, anything that grows on the farm and is in such condition as to decay and become a part of the soil is classed as manure. The passing of feed through animals does not add anything in the way of fertility. When grain and forage are fed, about three-fourths of the plant-food which was in the feed is excreted either in the dung or urine, the amounts varying with the kind of animals. The location of the feed lot should be such that this plant-food can be saved and returned to the soil. Expensive arrangements for the prevention of leaching and loss of plant-food are not necessary. But the manure pile should not be located in a draw, or on the bank of a creek where each rain will wash away valuable plant-food. A level spot or a small alkali spot make ideal places for the storing of manure until such time as it can be hauled into the fields.

Corn and cotton stalks and other rubbish in the fields are easily cut down and plowed under. This method requires but little more labor than raking together and burning and adds much to the fertility of the soil. When such material is dragged together and burned, both the nitrogen and the organic matter are lost, and both are greatly needed for the perpetuation of soil fertility.

Wheat straw instead of being burned should be used as much as possible and converted into manure to be returned to the soil for the benefit of future crops. It should never be burned.

Farmers near cities and large towns can procure large quantities of manure for only the labor of hauling it. Manure from livery stables is usually very rich, only a small amount of straw being used, and heavy grain feeding being the usual custom. The only difficulty with which the experiment station has met in procuring manure from stables in Stillwater has been inability to haul it away fast enough. It has been a grand opportunity to get something for nothing and the Station has taken advantage of it and manured portions of the farm so that they are no in a high state of fertility. Other portions have been left unmanured for comparison, but if the farm were conducted for profit, all of it would have been manured.

## GREEN MANURING.

The chief object of green manuring, or plowing under of crops, is to increase the supply of organic matter in the soil and to improve its mechanical condition. Some plants when plowed under actually increase the store of plant-food in the soil. These are known as leguminous crops and those that are successfully grown in Oklahoma are cowpeas, soy beans, peanuts, and alfalfa. The first of these is best suited for green manuring, but it is preferable to pasture the cowpeas off before turning them under. This can be done successfully by sowing cowpeas after wheat.

Some very sandy soils have been benefited by growing a crop of sorghum and plowing it under after it has attained nearly full growth.

The land should, of course, not be planted to crops immediately after plowing under a heavy crop of sorghum.

### SOIL EXHAUSTION.

As frequently considered, soil exhaustion is taken to mean lack of plant-food caused by continuous cropping without manure. It means much more than that, and includes a change in mechanical condition which hinders the growth of crops. This is brought about in many cases by the loss of organic matter. The failure of a soil to produce a satisfactory crop does not argue that there is a deficiency in the supply of plant-food in the soil.

The application of manure to the soil of the Station farm produced such marked results that an experiment was begun last season to determine whether or not the benefit was entirely due to the plant-food in the manure, or was in part produced by the change in the mechanical condition brought about by the organic matter in the manure. No definite results have yet been secured but the indications of the work up to this time are that the application of plant-food in the form of chemicals does not produce as satisfactory results as when applied in barnyard manure.

But few Oklahoma farmers have a thorough appreciation of the extent to which commercial fertilizers are used in the eastern and central western states. The use of artificial manures is crowding westward and many farmers in Iowa, Missouri, and eastern Kansas find their use necessary. It is not the intention to even suggest the desirability of using commercial fertilizers in Oklahoma, except possibly by gardeners and growers of small fruits. On the other hand, the evil day should be put off by caring for and using farm manures while the soil is yet comparatively new. Carelessness in such matters is nothing short of vicious.

### WHEN TO MANURE.

As has been indicated, the time of manuring should bear some relation to periods of greatest rainfall. The following tables give the average monthly, seasonal, and annual rainfall of nineteen stations in Oklahoma and Indian Territories, calculated from data furnished by C. M. Strong, Section Director, Oklahoma City, Okla.

### FALL AND WINTER RAINFALL.

AVERAGE OF NINETEEN STATIONS.

| October | November | December | January | February | March | Total |
|---|---|---|---|---|---|---|
| 2.64 | 2.02 | 2.09 | 1.79 | 1.12 | 2.11 | 11.79 |

### SPRING AND SUMMER RAINFALL.

#### AVERAGE OF NINETEEN STATIONS.

| April | May | June | July | August | September | Total |
|---|---|---|---|---|---|---|
| 2.92 | 4.93 | 3.84 | 4.50 | 2.53 | 2.27 | 20.99 |

Of a total average rainfall of 32.76 inches, 20.99 inches or nearly 65 per cent falls during the months from April to September inclusive. This fortunate distribution of rainfall is the controlling factor in crop production in .Oklahoma, and requires study so as to manure without loss the first season.

Generally speaking, manuring of the wheat crop is difficult because of the need of saving all of the soil moisture for the germination of the wheat. And as a general rule, if it is possible to do otherwise, wheat should not immediately follow the plowing under of manure. Green manuring may precede almost any spring crop, for the reason that this process usually diminishes the number of weeds. But applications of stable manure should, in most cases, be followed by some clean culture crop.

If cowpeas are grown for pasture and green manuring, they may follow wheat, being planted as soon as the wheat is cut. They will furnish considerable pasture during the late summer and fall, and may be plowed under during the late fall or winter. The land will then be in condition for a crop of oats, to be followed again by wheat and cowpeas. Stable manure may be hauled into the fields during the fall and winter, and applied to land that is to be used for corn, cotton, castor beans, Kafir corn, sorghum, broom corn and similar crops.

### SOIL MOISTURE.

Attempts to follow Kafir corn or sorghum with wheat have very often resulted in failure. "Kafir corn ruins the land" is an expression frequently heard in conversation with farmers. When the matter is studied, it is found that, after all, it is largely a question of the supply of moisture in the soil. Kafir corn grows a large mass of forage and uses the soil moisture up until the time of wheat seeding, and the wheat goes into a soil without sufficient moisture for the germination of the seeds and the growth of the plants.

Early plowing of land for wheat does little but prepare the soil so that it will take in water and keep it. Working the soil, keeping the surface loose, helps out a dry season by holding the water in the soil. Cultivation at the proper times is much to be preferred to manuring when there is no opportunity for the soil to fill with moisture before a crop is to be planted. The effect of a given crop on the moisture content of the soil has more to do with the yield of the next crop than does the amount of plant-food removed from the soil.

Cultivation and manuring—as much as possible of each—and study and knowledge of the true effect of different crops on available soil moisture are essential to a profitable and improved system of farming. The day of crop failures, worn out farms, and purchase of fertilizers should be put off by the use of things at hand that cost only energy, time, and labor to utilize and possess. JOHN FIELDS.

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## THE POTATO CROP*

### COMMERCIAL POTATO GROWING.

The largest district of commercial potato growing in Oklahoma is confined to the valley of the North Canadian river in Pottawatomie county. The soil in this district is well adapted to producing an early crop of potatoes and the work has been taken up by active, up-to-date farmers and pushed to its present high standing. It is now one of the best paying crops of that district. There are two crops grown each year, an early or spring crop, and a late or fall crop.

The soil of this district is a sandy loam and is an ideal potato soil. The subsoil is porous, containing a large proportion of sand. This insures good drainage and makes the land work easily and warm up early in the spring, which is a very essential feature for the spring crop. The clay loam lands will produce almost as large crops of potatoes but they will be later in season than those on sandy soil.

There is not much difference in the methods of planting and cultivation followed by the different growers. All the growers have almost the same kind of soil, grow the same variety of potatoes and for the same market. They are all striving to attain the same results, a large crop at an early date; and for this reason they follow practically the same process in growing a crop. This fact also accounts for the success of most of the growers.

The land is plowed in the fall or early winter when preparing for the early crop. This gives the soil time to settle and catch the winter rains and prepare for the drouth that usually comes in March and April. This drouth catches most of the early crop just as it is coming up and the young plants are beginning to depend on their own roots for food. If the

*Bulletin No. 52, December, 1901.

plants are not supplied with moisture at this time many will die and those living will be greatly weakened, even though plenty of rain should fall later on. This fall plowing keeps the soil in better condition and avoids turning under two or three inches of dry surface to help injure the crop. Deep plowing has uniformly given the best results.

## PLANTING.

The planting is done as soon as danger of hard frosts and freezes is past. This is about from the middle of February to the first of March. There are frosts later than this but they are seldom heavy enough to harm potatoes. There has been some planting done in January but it has not proven to be any better and is but little if any earlier in maturing the crop than later planting. In some of the earlier plantings last spring the potatoes started into growth and the vines were killed back to the surface of the ground by frost, but came up again and made a good crop.

Most of the planting is done with planters. The potatoes are cut about two eyes to the piece and the pieces are dropped from twelve to eighteen inches apart in rows about three feet apart. The potatoes are planted about two inches below the surface of the soil. The soil is then ridged up over the row until the seed is covered four to six inches deep. The earlier the planting is done the more the rows are ridged. This is done to protect the seed from the cold and hasten sprouting.

The seed used for this planting is that produced by the second crop of the previous year, or else it is shipped in from the north. The seed from the previous spring crop is sometimes used but has not given as good results as either the fall crop or the imported potatoes. The first crop of potatoes is difficult to keep over the summer on account of rot, and those that escape the rot dry and wither until they make very poor seed potatoes. The Bliss Triumph is the only variety grown to any extent for shipping. This is a very early medium-sized, red potato. Its special merit lies in its earliness and productiveness.

## CULTIVATION.

The cultivation begins with smoothing down the ridges over the potato row as son as the potatoes begin sprouting and before they are up. This work is done with a light harrow or drag that will work down the ridges and not disturb the seed. The subsequent cultivation is level and shallow, forming a dust mulch on the surface of the ground without breaking and destroying the roots of the plants. The cultivation is just frequent enough to keep the land free from weeds and the soil in good condition. The soil is gradually worked to the rows again and the last cultivation forms a distinct ridge about three or four inches high along the row. The cultivation is discontinued when the young potatoes are about a half inch in diameter. Cultivation later than this does no good and in some instances has done actual damage. The rows are sometimes cleaned with the hoe and this is about all of the hoe work that is done.

### HARVESTING.

The crop is harvested while the potatoes are still green and growing. The chief object is to put the crop on the market at the earliest possible date. The digging is done with potato diggers and plows. The potatoes are simply thrown to the surface of the soil and gathered up by hand. The sorting is done in the field as the potatoes are gathered up. The marketable ones are placed in sacks and immediately taken to market. The culls are thrown to one side and covered with soil to protect them from the sun until they can be planted for the second crop.

### THE SECOND CROP.

The culls from first crop form the seed for the second crop. The largest ones are usually cut about two eyes to the piece for planting and the smaller ones are planted whole. This seed sprouts very slowly on account of its being so green when dug and planted. The growth from this seed is very uneven, but this fault is overcome to a large extent by planting a large quantity of seed. Sometimes the seed rots badly, and gives a poor stand; when this happens the largest and ripest potatoes decay first and the smaller ones last.

The planting for the second crop is done during the last of June and the first of July. The method of planting and cultivating the second crop does not differ from that of the first crop. The crop is usually allowed to mature before harvesting.

### YIELDS.

The first crop yields from eighty to one hundred or more bushels of marketable potatoes per acre. Last summer most of this crop sold for from fifty to seventy-five cents per bushel delivered on the cars of the Choctaw, Oklahoma & Gulf railroad. The growers estimate the entire cost of the crop placed on the cars at ten to seventeen dollars per acre.

This leaves a good profit for the grower. The second crop does not usually make as large yields but a higher price is usually received for the crop. This crop, however, is well worth the growing if it only makes seed for the following spring crop.

Diseases and insects have done no noticeable harm as yet, and have not forced any thought or demand for spraying apparatus. The nature of the crop makes it convenient to crop the same land with potatoes year after year. This will rapidly reduce the value of the land for potato growing and hasten the spread of such diseases as scab and blight, after they are once started in the field. Some other crop should be grown on the land every other year. Such crops as corn, or wheat and cowpeas make good rotations with potatoes.

### VARIETY TESTS.

A test of varieties of potatoes has been carried on at the Station for the last two years. The land used in this test is a light upland loam. The seed was cut two eyes to the piece and planted two pieces to the hill, hills eighteen inches apart in rows three feet apart. The patch was given clean, shallow cultivation until the young potatoes were about one-half inch in diameter and then all cultivation ceased. The seed was all northern grown. The potatoes were all dug as soon as mature. The crop of 1901 was taken to the cave as soon as dug and placed in small boxes. The temperature of the cave ranged between 72 and 80 degrees Fahrenheit during July and August.

The following table gives the names and yields of the varieties grown. The potatoes of the crop of 1901 that were put in the cave were counted when placed in the cave and again on August 21 and September 24. The rotten potatoes were thrown out each time and from these counts the per cent of rotten potatoes was estimated:

| NAME | 1900<br>No. of Bushels per Acre | 1900<br>Per Cent of Crop Marketable | 1901<br>No. of Bushels per Acre | 1901<br>Per Cent of Crop Marketable | 1901<br>Per Cent of Crop Rotten Sept. 24 |
|---|---|---|---|---|---|
| Acme | ...... | ...... | 78 | 63.6 | 7 |
| Beauty of Hebron | 82 | 50 | 52 | 64.2 | 16 |
| Bliss Triumph | 66 | 80.9 | ...... | ...... | ......... |
| Bovee | 56 | 40 | 44 | 47.9 | 1 |
| Burbank | 54 | 42.9 | 31 | 36.9 | 2 |
| Burpee's Extra Early | 58 | 57.6 | 94 | 61.3 | ......... |
| Burpee's Superior | 59 | 57 | ...... | ...... | ......... |
| California Russet | 45 | 62.3 | ...... | ...... | ......... |
| Carmen No. 1 | 121 | ...... | 30 | 69.3 | 6 |
| Carmen No. 3 | 94 | ...... | 52 | 79.8 | 10 |
| Country Gentleman | ...... | ...... | 26 | 66 | 13.7 |
| Early Six Weeks | 213 | 82.4 | 69 | 56.4 | 3 |
| Early Rose | 123 | 62.8 | 61 | 63.3 | 10 |
| Early Kansas | 96 | 52.8 | 71 | 58.7 | 27 |
| Early Ohio | 90 | 49.3 | 83 | 63.4 | 5 |
| Early Fortune | ...... | ...... | 111 | 62.7 | 1 |
| Early Norther | 39 | 32.3 | ...... | ...... | ......... |
| Early Pingree | ...... | ...... | 47 | 46.4 | 11 |
| Early Puritan | 49 | 27.7 | ...... | ...... | ......... |
| Empire State | 92 | 95.5 | ...... | ...... | ......... |
| Extra Early Vermont | 108 | 57.1 | ...... | ...... | ......... |
| Great Divide | 95 | 42.1 | ...... | ...... | ......... |
| Good News | ...... | ...... | 105 | 60.7 | 9 |
| Ideal | 16 | 57.1 | ...... | ...... | ......... |
| Irish Cobbler | 161 | 80.7 | ...... | ...... | ......... |
| Joseph | ...... | ...... | 18 | 30.3 | 29 |
| Maggie Murphy | 72 | 69 | ...... | ...... | ......... |
| Rural New Yorker | 93 | 52.9 | 39 | 60.8 | 13 |
| Secretary Wilson | ...... | ...... | 97 | 44.2 | 11 |
| Sir Walter Raleigh | 23 | 40 | 43 | 49.7 | ......... |
| State of Maine | 77 | 67.8 | 60 | 56.7 | ......... |
| State of Wisconsin | ...... | ...... | 28 | 32.9 | ......... |
| Thoroughbred | 139 | ...... | 101 | 35.1 | ......... |
| Vigorosa | ...... | ...... | 66 | 66.6 | ......... |
| World's Fair | ...... | ...... | 35 | 14 | ......... |
| White Star | 116 | ...... | 79 | 68.9 | ......... |
| White Beauty | ...... | ...... | 48 | 39.3 | ......... |

## NOTES ON VARIETIES.

**Acme**; small; short, oblong, thick; eyes medium to large; skin pink, a little rough; very early.

**Beauty of Hebron**; large; oval; eyes few, shallow; skin white; early.

**Bliss Triumph**; medium to large; round, or a little flat; eyes deep; skin red; very early.

**Bovee**; medium to large; oblong, thick; eyes shalow, numerous; skin yellowish white with pink markings; early.

**Burbank**; medium size; long; eyes small; skin white; midseason.

**Burpee's Extra Early**; medium size; oval; eyes few, small; skin rose color; very early.

**Burpee's Superior**; large; long oval; eyes few, small; skin white; midseason.

**California Russet**; large; long; eyes few, medium size; skin white, covered with russet; late.

**Carman No. 1**; a little above medium size; broad oval, flattened; eyes few, medium size; skin white; midseason.

**Carman No. 3**; medium to large; broad oval, flattened; eyes few, medium size; skin white; late.

**Country Gentleman**; medium to large; oblong to long, flattened; eyes large, shallow; skin pink; late.

**Early Six Weeks**; medium size; round; eyes deep; skin rose color; very early.

**Early Rose**; medium size; oval to long; eyes medium size; skin rose color; early.

**Early Kansas**; medium size; long oval; eyes medium size; skin white, a little russet; early.

**Early Ohio**; medium size; oval; eyes medium size; skin light rose color; very early.

**Early Fortune**; large; oblong; eyes few, medium size; skin white; early.

**Early Norther**; medium to large; oblong; eyes large, deep; skin white; early.

**Early Pingree**; medium size; oval to long; eyes few. small; skin white; early.

**Early Puritan**; medium to large; oval; eyes large, shallow; skin white; early.

**Empire State**; very large; long; eyes large, deep; skin white; late.

**Extra Early Vermont**; large; round to oval; eyes large, shallow; skin light rose; early.

**Great Divide**; large; oblong, slightly flattened; eyes small; skin white; midseason to late.

**Good News**; large; long, cylindrical; eyes shallow; skin smooth, white; late.

**Ideal**; small; long. slightly irregular; eyes few, small; skin light red; early.

**Irish Cobbler**; medium size; short, oblong; eyes medium deep; skin white; midseason.

**Joseph**; medium size; oval; eyes small; skin red; late.

**Maggie Murphy**; medium size; broadly oval; eyes few, medium size; skin light rose netted; late.

**Rural New Yorker No. 2**; medium size; oblong, usually pointed; eyes few, shallow; skin white, netted; late.

**Secretary Wilson**; medium size; oval, flat; eyes large, shallow; skin white; midseason.

**Sir Walter Raleigh**; medium size; round to oval; eyes few, medium size; skin white; midseason.

**State of Maine**; large; round; eyes large, shallow; skin white; late.

**State of Wisconsin**; large; long; eyes medium size, deep; skin white; late.

**Thoroughbred**; medium size; oblong; eyes small, shallow; skin light rose; early.

**Vigorosa**; large; flat, oblong and sometimes irregular; eyes shallow, large; skin red; late.

**World's Fair**, medium size; oval; eyes shallow; skin white, very finely netted; late.

**White Star**; medium size; round to oblong; eyes medium size, shallow; skin white; late.

**White Beauty**; large; long to oval; eyes few, small, shallow; skin white; late.

## FALL AND SPRING PLOWING.

The potato growers in Pottawatomie county generally agree that their experience and observation proves that the land should be plowed in the fall before the potato crop is planted in the spring. The soil in that district is a sandy loam. The soil on the Experiment Station farm is a light upland soil mixed with some hard pan or clay. The results of experiments in fall and spring plowing on this soil coincide with the results on the sandy loam.

The results of several experiments along this line differ so little that the result of only one test is given. The field was divided into forty-eight plats of equal size. Twelve plats were on land that was plowed in October before the crop was planted in March. These plats made an average yield of 95.5 bushels of marketable potatoes per acre. Twelve were on land that was plowed seven inches deep and subsoiled five inches deep just before the crop was planted. These plats made an average yield of 72.5 bushels of marketable potatoes per acre. The other twenty-four plats were on land that was plowed about seven inches deep just before the crop was planted. These plats made an average yield of 73 bushels of marketable potatoes per acre.

## DEPTH OF PLANTING.

The depth at which the seed should be planted varies with the season and condition of the soil at the time of planting. In very cold or very warm weather the seed should be covered a little deeper than at other times, or if the soil is very dry the seed may be planted a little deeper than would otherwise be advisable. The yield of the plants that were planted to test this point varied from those in which the seed was planted in furrows three to four inches deep and then filled level full of soil, which was 84 bushels of marketable potatoes per acre; to those planted in furrows about eight inches deep and covered with three inches of soil which made forty-seven bushels per acre. The deep furrows were gradually filled by cultivation.

The seed should always be planted in moist soil and covered immediately. The potato planters do almost ideal work in this respect, but in small patches where the rows are laid out with a plow and the seed dropped by hand, the soil in the open furrow is dried and the sprouting of the seed retarded thereby. This can be observed every year but it is especially noticeable if the planting is done during a dry spell. Last spring potatoes planted in furrows that had been left open for one to two days and exposed to the wind, were as much as two weeks later in coming up, than those planted in fresh furrows on the same day.

## TIME OF PLANTING.

The best time for planting early potatoes varies with each season, and no definite date can be named. The seed should not be planted until the soil is warm enough to start it into growth at once. If the seed lies in moist, or wet soil a week or two before growth starts, a good part of it will be destroyed by rot. Last spring, potatoes planted March 14 came up as early and matured the crop as early as those planted February 27. The crop planted about the middle of March has usually been as early as that planted in February and has made a larger yield by having a better stand of plants. On sandy soil and in the southern part of the territory, the planting can be done much earlier.

## CULTIVATION.

Shallow cultivation, frequent enough to keep down the weeds and the surface of the soil well pulverized, is best. The early cultivation should leave the land as level as possible, but later on the soil should be drawn to the row enough to make a distinct ridge. The land must be kept free of weeds and grass. Small patches of midseason and late potatoes can be mulched profitably with old hay or straw. The early crop frequently can also be mulched with profit. A comparison of the yield of cultivated and mulched plats shows greatly in favor of the mulched plats. Sixteen cultivated plats of the crop of 1899 made an average yield of eighty-four bushels of marketable potatoes per acre. Five mulched plats made an average yield of 111 bushels of marketable potatoes per acre. This was a midseason crop. The crop of 1900 gave practically the same results as that of the year before. In the crop of 1901 the mulched plats made about four times as large a yield as the cultivated plats. This however, was an exceptionally dry season and such results are far out of proportion for the average season.

### KEEPING POTATOES.

The early potatoes usually make a fair crop and there are few questions asked about methods of planting and cultivating them. The crop of midseason and late potatoes is usually very poor. There seems to be no method of cultivation that will enable any variety of late potatoes to make even a fair crop each year. Mulching the patch with old hay or straw gives the best results. The mulch should be from six to ten inches deep when first spread on the ground.

The trouble that confronts almost every farmer in Oklahoma is, how to keep a crop of early potatoes through the summer and early fall so that he can have his own potatoes for use during the winter. This year is an extreme but it illustrates the situation all the better.

In July potatoes sold for fifty cents per bushel in Stillwater and now, December 13, they are worth $1.20 per bushel. If the farmer could have kept the early crop the price would not have been so low in July and August nor so high now. Most farmers lose a large per cent of their potato crop each year by the rot and count on losing it. The result is that few farmers keep enough of their own crop for family use, others buy all they use during the winter and spring and many others are not using potatoes this year.

Many methods of keeping the early crop have been tried but only a few have been even partially successful. Several methods have proved quite satisfactory one year and have been entire failures the next year, and no method that can be used by the average farmer has to our knowledge given even a fair degree of satisfaction for two or three successive years.

Four different methods of keeping the potatoes through the summer in the soil where they grew have been advocated. The first and most common method attempted is to let the potatoes remain in the soil undisturbed till fall. This plan is almost regularly a failure. The potatoes are only two or three inches under the surface of the soil and are heated through till they rot. A rain in the middle or latter part of the summer will cause most of the sound ones to sprout. Last summer one plat was treated this way and when the crop was dug early in the fall eighty per cent of the potatoes were rotten, and the remaining twenty per cent have not kept well since then. In 1900 the loss on a similarly treated plat was somewhat less. In some plats where the weeds and grass were very thick the loss was about forty per cent.

Another method is to leave the potatoes in the ground and go through the field with a lister or turning plow and throw up a ridge over the row. This, if well done, will cover the potatoes with six to eight inches of soil. This work should be done as soon as the crop is mature. In 1900 a plat treated in this manner lost twenty per cent of the crop before fall. In 1901 this plat lost sixty per cent of the crop before September 1. There was no appreciable loss either year from sprouting. This plan is better than leaving the land level but is a very poor method. It has given fair results on sandy soil but even there failures are frequent.

In the third method the land is left level and about the time the last cultivation is given or shortly before the crop is mature, a row of cowpeas are drilled on either side of the row of potatoes as close as the drill can be run to the vines. The peas will make a good growth over the row and shade the land and reduce the amount of moisture in the soil during the summer. This plan was followed with two plats in the summer of 1900 and about sixty per cent of the crop rotted. No difference could be seen between these plats and those left without any covering. In 1901 this plan was followed again and about seventy-five per cent of the crop rotted.

The fourth method of keeping the crop in the field is to mulch the patch with straw or old hay in the spring or in the summer after cultivation has ceased. Plats mulched in the spring of 1900 and the crop dug in the fall lost by rot about five per cent. Plats treated in the same way in 1901 lost about fifteen per cent by rot. This is by far the best of the four methods just discussed. It is a practicable method to follow on farms where potatoes are grown only for use. The potatoes kept in this way in better condition and have a better appearance than those kept through the summer in a cave. The mulched plats will on an average keep as many bushels per acre until fall as the cultivated plats will yield if dug as soon as the crop is mature.

Keeping the potatoes by packing them in sand in the cave resulted in a loss of twenty-five to fifty per cent by rot. In the first lot the potatoes were packed in a box of sand so that no two touched each other or the sides or the bottom of the box. In the second lot each potato was wrapped in paper and then packed in the sand the same as the first lot. There was very little if any difference in the per cent rotten in the two lots. Both lots sprouted worse than other potatoes in the cave. A few were wrapped in paper and placed in a box in the cave. This bunch lost about twenty per cent.; the same as other potatoes placed in the cave at the same time.

Quick or unslacked lime was pulverized and dusted over the potatoes, in a bin in the barn, so that every potato was covered with the fine dust. They were placed in the bin July 6, 1901, and the lime dusted on immediately. They were removed October 1, and had lost forty-one per cent by rot. Another lot was dusted with lime in the same way at the same time and placed in the cave. This lot lost ninety per cent by rot.

Copper sulfate (blue vitriol) was pulverized and dusted very lightly over one lot of potatoes on July 6 and they were immediately placed in a bin in the barn. This lot lost forty per cent by rot by October 1.

Salt was pulverized and dusted over a lot of potatoes about the middle of July. They were placed in the cave where it took about four weeks for the entire lot to decay.

One lot of potatoes was coated with paraffin by dipping each one in melted paraffin. The temperature of the paraffin was 160 degrees Fahrenheit, and the potatoes were simply dipped in and lifted out immediately. This gave a very thin but practically air-tight coating to each one. The potatoes were all clean and sound. The work was done in July 1901 and the entire lot decayed in two weeks.

Dipping the potatoes in Bordeaux mixture, ammoniacal copper carbonate, and formaldehyde, was tried but the results indicate that the work does more harm than good. The potatoes dipped in any one of these solutions rotted two to six times as rapidly as those not treated.

Keeping potatoes in an open shed has been advocated and practiced by some farmers. Mr. J. W. Poling of Oklahoma City says: "I kept some potatoes one year by placing them in a corn crib as soon as they were dug. The crib was well covered and so situated that the sun could not strike the potatoes. They were simply placed on the floor of the crib in early summer and left there until fall, and kept in fair condition. The second trial, however, ended in a failure."

This method was tested here and resulted in a failure. The potatoes were sorted and only the good ones used. The sound potatoes were spread about two or three deep on the floor of a small bin in a closed shed at the north end of the barn. They were not handled or moved in any way during July, August and September. When they were taken from the bin, October 1, twenty-one per cent were rotten. A similar test in the summer of 1900 resulted in about forty per cent rotten.

Good results have been obtained at times by piling the potatoes on straw in the shade of trees and then covering the pile with about two feet of straw. A heavy rain will cause all of the potatoes to sprout or rot. The test of this method here last summer resulted in seventy-seven per cent of the pile rotting. The test lasted from July 6 to September 30. There was not enough rain during the summer to wet through the covering and wet the potatoes.

The average cave will not keep the crop through the summer. The Bliss Triumph lost about fifteen per cent of those placed in the cave early in the summer in 1901. The average temperature was 73 degrees. Those that did not rot sprouted badly and are now unfit for table use. There is a great difference, however, in results, depending upon the way potatoes are handled and stored. Those piled on the floor of the cave rotted badly, those left in sacks kept somewhat better but are in a very bad condition now. Those kept in small boxes or crates did the best and justify the statement that in good caves good potatoes may be kept through the summer with little loss if properly handled.

If the potatoes are to be stored in the cave through the summer they should be dug as soon as growth has ceased. If they remain in the ground until they are ripe their keeping qualities will be greatly impaired. This is especially true if the patch is not mulched. The potatoes that are a little green when dug keep better in caves than those that are mature. The green ones will wilt if kept in too dry a place but if the cave floor is a little moist they will keep in fair condition. They require ventilation but should not be in a direct draft of air.

The heat is no doubt the principal cause of decay. In testing this last summer, it was found that freshly dug potatoes were badly damaged by being heated to 110 Fahrenheit degrees while those that had been dug for some time and wilted a little could be heated to 120 degrees without any noticable harm being done to their keeping qualities. Heating potatoes to 100 degrees for one hour each did more harm than heating to 110 degrees for the same number of hours taken consecutively. Potatoes placed in closed or nearly air-tight vessels and heated to 100 degrees and left in these vessels decayed in two weeks.

The best method tested is to grow the potatoes under a mulch of hay or straw and leave them in the ground till fall. If rain should cause them to start to sprout or decay they should be dug and stored in small boxes or crates in a cave. If the patch is not mulched the crop should be dug as soon as matured and stored in a cave. The potatoes should not be left in the sun but should be taken to the shade as fast as they are dug.

O. M. MORRIS.

## VARIETY TESTS OF CABBAGE.*

A variety test of cabbage has been carried on for the last two years. The plants were started in the hot bed and set in the field as soon as the conditions of the weather would permit. The plants were set three feet apart in rows three and one-half feet apart in 1900, and in rows six feet apart in 1901. The following table gives the name and yield of each variety. In 1900 twenty-five plants of each variety were set. In 1901 thirteen plants of each variety were set.

| | 1900 | | | 1901 | | |
|---|---|---|---|---|---|---|
| | No. of Heads | Total Weight | | No. of Heads | Total Weight | |
| | | Lbs. | Oz. | | Lbs. | Oz. |
| North Carolina Winter | 18 | 65 | 14 | Not Planted | ...... | ...... |
| Augusta Early Trucker | 20 | 43 | 9 | Not Planted | ...... | ...... |
| Early Jersey Wakefield | 17 | 34 | 1 | Failure | ...... | ...... |
| Early Winningstadt | 5 | 4 | 6 | Failure | ...... | ...... |
| Large Early York | 10 | 15 | 1 | Failure | ...... | ...... |
| Dwarf Early York | 6 | 9 | 6 | 3 | ...... | 6 |
| Extra Early Etampes | 7 | 11 | 10 | Failure | ...... | ...... |
| Surehead | 19 | 26 | 12 | 2 | 4 | 14 |
| Early Express | 6 | 6 | 5 | Failure | ...... | ...... |
| Fottler's Improved Brunswick | 8 | 11 | 1 | Failure | ...... | ...... |
| Large Late Drumhead | 16 | 25 | 4 | 3 | 6 | 9 |
| Henderson's Early Summer | 13 | 25 | 10 | 5 | 4 | 2 |
| Allseasons | 20 | 50 | 10 | 1 | ...... | 12 |
| Premium Late Flat Dutch | 16 | 24 | ...... | 2 | 2 | 12 |
| Drumhead Savory | 2 | 1 | 5 | Failure | ...... | ...... |
| Mammoth Rock Red | 14 | 9 | 1 | 1 | ...... | 6 |
| Early Dwarf Flat Dutch | 14 | 31 | 1 | Failure | ...... | ...... |
| Mammoth Marble Head | 17 | 24 | 4 | 1 | ...... | 6 |
| Excelsior | 13 | 28 | 6 | 6 | 9 | 3 |
| World Beater | 18 | 20 | 4 | Not Planted | ...... | ...... |
| Vandergraw | 21 | 27 | 11 | Not Planted | ...... | ...... |
| Henderson's Early Summer | 20 | 32 | 15 | Not Planted | ...... | ...... |
| Lupton | 22 | 44 | 11 | Failure | ...... | ...... |
| Allhead Early | 22 | 62 | 14 | 2 | ...... | 9 |
| Henderson's Succession | 14 | 21 | 14 | Not Planted | ...... | ...... |
| Green Glazed | 1 | ...... | 12 | Not Planted | ...... | ...... |
| Safe Crop | 20 | 35 | 13 | Not Planted | ...... | ...... |
| Early Spring | 17 | 27 | 11 | Failure | ...... | ...... |
| Filderkraut | 21 | 21 | 12 | Not Planted | ...... | ...... |
| New Savory | 6 | 1 | 11 | Failure | ...... | ...... |
| Hollander | Not Planted | | ...... | 3 | 2 | 6 |
| Succession | Not Planted | ...... | ...... | 2 | 1 | 6 |
| Golden Sugar Winter | Not Planted | ...... | ...... | Failure | ...... | ...... |
| Louisville Drumhead | Not Planted | ...... | ...... | Failure | ...... | ...... |
| Large Jersey Wakefield | Not Planted | ...... | ...... | Failure | ...... | ...... |

North Carolina Winter; stem short; head nearly round, soft until almost grown; leaves large; midseason.

Augusta Early Trucker; stem short; head round to flat; medium firm throughout growth; rots badly at stem; midseason.

Early Jersey Wakefield; stem medium length; head long, conical, medium firm; sun-scalds badly, decays as soon as mature; early.

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*From Bulletin No. 52, December, 1901.

**Early Winningstadt**; stem medium length; head conical, firm; sunscalds and decays badly; early.

**Large Early York**; stem medium length; head long, firm rots soon after maturity; early midseason.

**Dwarf Early York**; stem short; head long, very firm, decays and sunscalds badly; very early.

**Extra Early Etampes**; stem short; head long, firm. A good variety.

**Surehead**; stem medium length; head round or flat; late. A good variety.

**Early Express**; stem medium length; head conical to round; sunscalds badly; early. Very poor.

**Fottler's Improved Brunswick**; stem short; head flat, very firm; midseason.

**Large Late Drumhead**; Stem long; head flat, firm when mature; late.

**Henderson's Early Summer**; stem very short; head flat, cracks badly, but does not rot; early midseason.

**All seasons**; stem medium length; round or slightly flattened, very firm throughout growth; late. Good.

**Premium Late Flat Dutch**; stem short; head firm, flat; stands drouth very well. A very good late cabbage.

**Drumhead Savory**; did not head.

**Mammoth Marble Head**; stem medium length; head round, firm, free from rot

**Early Dwarf Flat Dutch**; stem medium length; head round, very firm; early; sunscalds and rots badly.

**Mammoth Marble Head**; stem medium length; head round, firm, free from rot and sunscalds, late.

**Excelsior**; stem medium to long; head. round firm, free from rot; late. Good.

**World Beater**; stem medium length; head round, very firm; late.

**Vandergraw**; stem short; head round, free from sunscald and rot; late.

**Lupton**; stem long; head flat, firm; midseason; good.

**Henderson's Succession**; stem medium length; head flat, firm; midseason.

**Green Glazed**; stem long; head small. Not good. Late.

**Safe Crop**; stem short; head flat, firm; late.

**Early Spring**; stem short, head flat, firm; late.

**Filderkraut**; stem medium length; head conical; late.

**New Savory**; stem short, head very small, soft. Not good.

**Hollander**; stem tall; head small, round, firm throughout growth; late.

**Succession**; see **Henderson's Succession**.

O. M. MORRIS.

# Reprints from the Eighth Annual Report,

## 1898-1899.

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## AGRICULTURAL EXPERIMENT STATION.

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### ANNOUNCEMENT.

The Oklahoma Agricultural Experiment Station is a department of the Oklahoma Agricultural and Mechanical College. It receives no funds from the Territory and is supported by an annual appropriation of $15,000 from the National Treasury.

The act of Congress establishing this and similar institutions defines their duty in the following language:

"That it shall be the object and duty of said experiment stations to conduct original researches or verify experiments on the physiology of plants and animals; the diseases to which they are severally subject, with the remedies for the same; the chemical composition of useful plants at their different stages of growth; the comparative advantages of rotative cropping as pursued under a varying series of crops; the capacity of new plants or trees for acclimation; the analysis of soils and water; the chemical composition of manures, natural or artificial, with experiments designed to test their comparative effects on crops of different kinds; the adaptation and value of grasses and forage plants; the composition and digestibility of the different kinds of food for domestic animals; the scientific and economic questions involved in the production of butter and cheese; and such other researches or experiments bearing directly on the agricultural industry of the United States as may in each case be deemed advisable, having due regard to the varying conditions and needs of the respective States or Territories."

Due regard to the conditions and needs of this Territory has determined which of these permissible investigations should be pursued by this Station. And due regard for careful work and results of ultimate value has made the choice of a few definite lines pursued to their end preferable to a little work on each of a great many lines.

The proper work of the Station is, therefore, to determine and suggest applications of general principles rather than to formulate rules of practice. The work of the Station should be of value to the largest possible number rather than to a few individuals. This fact and the limitations of time make it impossible for the Station to undertake investigations unless it is probable that the results will be valuable to many.

Suggestions as to desirable lines of work are invited and will be carefully considered when planning future experiments.

The Station will gladly give any information in its possession on any subject connected with agriculture, in response to request.

Members of the Station staff will aid in the work of farmers' institutes whenever possible.

A cordial invitation is extended to all to visit the Station at any time and inspect the work which is being done.

The bulletins of the Station are now sent to more than 13,000 farmers and others. They are sent, without charge, to any one in the Territory sending name and address.

Address all communications to

AGRICULTURAL EXPERIMENT STATION,
Stillwater, Oklahoma.

# FEEDING EXPERIMENTS.

## 1896—1899.

G. E. Morrow and J. H. Bone.

### SUMMARY AND GENERAL CONCLUSIONS.

Oklahoma is well adapted to rearing and feeding horses, cattle, sheep and hogs. Few things would add more to its prosperity than a large increase of attention to stock rearing by a majority of its farmers.

Where corn can be raised with reasonable certainty of a good crop it will be found the best fattening food. Its fodder and stover are also valuable foods, although the long time after ripening before winter feeding begins causes more loss in the shock and much more to the standing stalks than in more northern states.

As the kernels become very hard when thoroughly dried, grinding the corn is a help; soaking is a fair substitute for this. Where hogs follow cattle there is little loss when either ear or shelled corn is fed.

Kafir corn is a healthful, palatable and nutritious food, but its feeding value is somewhat less than that of corn. As shown both by feed lot trials and by digestion experiments there is a great loss in feeding this grain unthrashed to cattle—in some cases of sixty per cent but hogs will utilize most of this waste. There is little difference in the waste whether the grain is fed unthrashed or thrashed. In some cases, at least, the loss is greater when soaked grain is fed than when it is fed dry. In some trials steers fed Kafir meal made better gains for a long time than did those fed corn meal, but this was not true in any extended period. Hogs digest the unground grain better than do cattle. In general hogs have made gains from four-fifths to five-sixths as great when fed on Kafir as when fed corn. Sheep seem to digest Kafir better than any other class of farm animals.

Kafir stover apparently has practically the same feeding value as corn stover, and often is in better condition. Running the entire stalk through a thrashing machine puts the stover in excellent condition.

Alfalfa is the best hay for either horses, cattle or sheep and is a help to hogs during winter. The value of cowpea and soy bean hay is underestimated by most Oklahoma farmers. No larger gains have been made by cattle at the Station than when cowpea hay was their only rough forage.

The trials at the Station indicate that it is not profitable to keep good grade native steers until they are three years old and that it is possible that sales when they are "long yearlings" may be most profitable.

Apparently six months is as long as it is profitable to continue full grain feeding of cattle under existing conditions. The rate of gain decreases as the animals become fat and the quantity of food needed to produce a pound of gain greatly increases in many cases.

The result of one trial suggests possibilty of greater profit when steers are not given all they can eat of grain, taking a longer period for fattening. This would pretty certainly be true where there is an abundant supply of good alfalfa or cowpea hay, and grain is high priced.

One or two striking illustrations of the fact that an ill-formed animal may make as large gains as well formed ones have been found in the Station feeding trials. The lower price at which the ill-formed steer sells will more than counterbalance any seeming profit from his purchase.

Oklahoma native pastures are good, but the gains made by cattle on them, especially when flies are bad or there is extreme heat, are often over-estimated. It is desirable to have sorghum, Kafir or corn with which to supplement the pastures during the fall or summer drought.

Alfalfa is excellent as pasture for hogs. Pigs will make some gain with no other food; excellent gains when fed grain while on the alfalfa. Continuous pasturing will injure and may destroy the alfalfa. With rare exceptions, alfalfa should not be pastured the year it is sown. Sorghum also makes a fair pasture for hogs. Sowing cowpeas, planting peanuts or sweet potatoes and allowing hogs to harvest the crop giving them some grain in addition reduces the cost of pork production. Sugar beets are much relished by any class of stock. The greater cost of growing them as compared with other crops makes it doubtful if they are an economical crop when used in large quantities.

A large increase in the number of sheep in the territory is advised. They thrive well, the cost of keeping in summer is very small, and Oklahoma has many advantages as regards the production of lambs for the early spring market.

Shelter should be provided for all classes of stock, but expensive buildings and stall feeding of cattle are not necessary. While there is, occasionally, extreme cold, ordinarily protection from rain and cold winds by means of simple sheds is all that is needed for the comfort of farm animals.

The long continued feeding of hogs on dry feed of any class is not advisable. Almost without exception the grain eaten for each pound of increase somewhat rapidly increases after hogs of any age have been full fed on dry feed for 8 weeks or more.

## FEEDING EXPERIMENTS.

The work in stock feeding has been with chief design of using foods which can readily be grown on almost any Oklahoma farm, using simple rations and preparing the food with as little cost as is practicable.

The Station has not yet been able to provide satisfactory facilities for feeding experiments. Thus it has been found not easily practicable to determine quantities of hay, stover or other forage eaten by each animal.

Possibly in even greater degree than with experiments in crop culture, care should be taken in drawing definite conclusions from single experiments in feeding or those with small number of animals. Differences in feeding capacity of animals of like age and breeding are great in some cases. Sudden variations in the weather or some unknown cause may greatly affect results. In several trials at this station greater differences in results have been found between animals under like treatment than between selected animals and different rations.

The gains made by animals in experiment feeding are often smaller than they would be if a greater variety of food was given with occasional changes in the ration.

## STEER FEEDING—1898-9.

Nine two-year-old steers were fed during winter of 1898-9, mainly to compare value of Kafir and Indian corn as grain food. With one exception these steers were of fair quality, showing considerable Shorthorn blood—except two which probably were grade Angus and Shorthorn. They had been on full feed during the previous winter, were put on pasture May 9. From this date until September they made average gain of 163 lbs., varying from 25 to 280 lbs., per steer. During September they were fed new ear corn in the pasture, making average gain of 73 lbs. each, varying from 10 to 120 lbs., each. October 1 they were brought to small pasture near stable, kept under like conditions until October 24, making average gain of only 10 lbs., each, largely because of being placed on dry feed.

October 24 they were divided into five lots, with an extra Texas steer used for inoculation experiments as second member of fifth pair, the other being a rough-formed steer and the purpose being to dispose of this pair as soon as practicable.

| | |
|---|---|
| Lot 1 full feed of Kafir meal, average weight ........ | 1005 lbs. |
| Lot 2 full ration corn meal, average weight ...... | 945 lbs. |
| Lot 3 full ration corn and Kafir meal, half and half, average weight ........................ | 990 lbs. |
| Lot 4 Kafir meal, approximately one pound for each 100 lbs. live weight for 10 weeks; afterwards full ration, average weight ............ | 930 lbs. |
| Lot 5 full ration corn meal, average weight ........ | 935 lbs. |

All the steers had all they would eat of Kafir stover. It was impracticable, with the facilities at hand, to determine quantity eaten by the different animals.

The Texas steer was sold after 13 weeks feeding. After this the feed given the ninth steer is known.

While some attention was paid to color and appearance the pairs were selected with chief reference to supposed uniformity in feeding capacity. The results were surprising in some cases, the differences in the gains made by the steers in each pair being very great. There was an extreme difference of 75 lbs., in weight of the lots. The average weight of the nine steers was 964. lbs.

A summary of results by four weeks periods and whole period of 24 weeks, showing gain of each steer, of each pair, average gain for each pair per day, grain eaten and number of pounds of grain for one pound gain in live weight is given in table.

Gains and grain per pound. Gain 4 weeks periods, October 24 to April 10.

Gains by Periods.

| | Lot 1 | | | Lot 2 | | | Lot 3 | | | Lot 4 | | | Lot 5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | Av. | 1 | 2 | Av. | 1 | 2 | Av. | 1 | 2 | Av. | 1 |
| Period 1. | 105 | 65 | 85 | 95 | 100 | 97 | 140 | 65 | 102 | 75 | 30 | 50 | 120 |
| Period 2. | 75 | 60 | 67 | 80 | 80 | 80 | 40 | 60 | 50 | 30 | 95 | 62 | 75 |
| Period 3. | 35 | 50 | 42 | 60 | 50 | 55 | 70 | 70 | 70 | 65 | 35 | 50 | 40 |
| Period 4. | 100 | 70 | 85 | 45 | 15 | 30 | 75 | 40 | 57 | 10 | 70 | 40 | 90 |
| Period 5. | 85 | 85 | 85 | 80 | 70 | 75 | 45 | 45 | 45 | 75 | 30 | 52 | 50 |
| Period 6. | 55 | 25 | 40 | 5 | 60 | 32 | 70 | 45 | 57 | 50 | 60 | 55 | 85 |

| | Average Daily Gain. | | | | | Pound Grain Per Pound Gain. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Lot 1 | Lot 2 | Lot 3 | Lot 4 | Lot | Lot 1 | Lot 2 | Lot 3 | Lot 4 | Lot 5. |
| Period 1. | 3.00 | 3.48 | 3.66 | 1.87 | 4.30 | 6.58 | 5.74 | 5.67 | 5.35 | |
| Period 2. | 2.41 | 2.86 | 1.78 | 2.23 | 2.67 | 8.68 | 7.33 | 11.94 | 4.92 | |
| Period 3. | 1.52 | 1.96 | 2.50 | 1.78 | 1.43 | 15.34 | 11.54 | 9.42 | 8.92 | |
| Period 4. | 3.00 | 1.17 | 2.07 | 1.43 | 3.21 | 7.51 | 21.46 | 11.25 | 12.70 | |
| Period 5. | 3.00 | 2.67 | 1.60 | 1.87 | 1.78 | 6.75 | 7.90 | 13.30 | 11.16 | 13.20 |
| Period 6. | 1.43 | 1.16 | 2.07 | 1.96 | 3.00 | 14.51 | 18.20 | 10.05 | 12.15 | 7.90 |

There was a difference of 100 lbs. in gain made by the two steers in Lot 1; of 115 lbs. in that made by the two in Lot. 3. Those in Lots 2 and 4 made nearly the same gain. There was also much variation in the gain made from week to week. Some of these variations can be explained by changes of weather; others it is difficult to account for. No one of the steers was sick or noticeably "off feed" at any time. They were fed carefully and with regularity. During the day they had range of an open yard with Kafir stover in racks. The grain was fed in troughs in a comfortable stable.

Naturally the rate of gain declined toward the close of the feeding period as did the quantity of grain eaten. If the cattle had been fed for profit only it would have been better to have varied the ration, giving some bran or cottonseed meal and also alfalfa or some other forage with more nitrogenous matter than has Kafir stover.

The daily gain per steer in each lot is given below in two periods of 12 weeks each, except for Lot 4 which did not have full grain rations during first period:

| | Lot 1. | Lot 2. | Lot 3. | Lot 4. | Lot 5. |
|---|---|---|---|---|---|
| First Period 12 weeks | 2.32 lb. | 2.75 lb. | 2.64 lb | | 2.80 lb. |
| Second Period, 12 weeks | 2.50 lb. | 1.63 lb. | 1.90 lb. | 1.75 lb. | 2.68 lb. |

An exception to the rule is found with Lot 1 which gained more in second than in first period.

One of the most interesting features of the trial is the fact that the least desirable steer in the bunch, so far as form is concerned, made a slightly larger gain than any other steer, and continued good gains during whole feeding period. The grain given him for first 13 weeks cannot be determined. During last 11 weeks he ate an average of 23.6 lbs. corn meal daily somewhat more than any other steer, and made average gain of 2.73 lbs., daily, using 8.85 lbs., corn meal for each pound of gain. It does not follow that it is more profitable to feed ill formed steers than well formed ones. The poorer steer would not sell for as high a price as would the better one on any market. The small Texas steer fed with this inferior steer made a gain of 2.25 lbs., daily for seven weeks; but only 30 lbs in next six weeks, at which time he was sold.

The bunch of nine steers attracted much favorable comment as unusually well fattened. They sold in the quarantine division of the Kansas City Stock Yards at $4.75.

Lot 4 was fed for ten weeks a limited grain ration, averaging 10.8 lbs. Kafir meal each per day. The average weight per steer for this period was almost exactly 1,000 lbs. They made creditable but not large gains per day, but the rate of gain in proportion to grain fed was very good, as they used but 5.51 lbs., grain for each pound gain during the whole period —less than this for first eight weeks. It is easily possible that the profit was greater from this lighter than from full grain feeding of the other lots. The relative cost of grain and rough forage, the importance of getting the animals ready for market in a given time, and other considerations must decide which course should be adopted.

## STEER FEEDING. 1897-8.

Ten steers of fair quality, eight of them yearlings, two two years old, were placed on pasture May 1. From this time until September 28, they made average gain of 102 lbs. each. During October they were fed Kafir fodder on a small pasture, making average gain of 44 lbs., each.

From November 1 to December 6, five weeks, they were fed broken ear corn in troughs with cowpea hay and Kafir stover. Five steers made average gain of 103.5 lbs. or 2.95 lbs., daily. The second lot made gain of 94.4 lbs. or nearly 2.70 lbs., daily.

During week Dec. 6-13 they were stabled, accustomed to being haltered and to eating meal. For four weeks from Dec. 13 to Jan. 10, Lot 1, fed Kafir meal, averaged 102 lbs., gain or 3.64 lbs., daily eating a little over 7 lbs., meal for each pound gain. Lot 2, fed corn meal, made average gain of 62 lbs., or 2.21 lbs., daily eating 10.7 lbs. meal for each pound gain.

The difference in gain was so great that it was thought advisable to change the feed of the two lots. For two weeks all were fed a mixture of corn and Kafir meal. During this time Lot 1 gained only 24 lbs., Lot 2, 54 lbs.

From Jan. 24 to March 1, Lot 1 was fed corn meal, instead of Kafir as before, making gain of 305 lbs., average 61 lbs., or 1.69 lbs., daily eating 12.93 lbs., meal for each pound gain. Lot 2, fed Kafir meal made gain of 255 lbs., average 51 lbs, each or 1.42 lbs., daily eating 17.9 lbs., meal for each pound gain. These results leave it inconclusive whether differences in gain were principally because of feed or of difference in the cattle.

### STEER FEEDING. 1896-7.

Various circumstances made this work unsatisfactory. During a part of the winter satisfactory scales were not available; there were breakages of the grinding machinery making some changes of ration necessary.

Twenty young steers, part calves, and part "long yearlings," not very uniform in character were fed in five lots of four each. One lot was fed in racks and troughs in a well protected yard; the other four lots were fed in large box stalls, too small for greatest comfort of the animals. During the day they had access to a large lot. The average weight of the steers in the several lots, October 15, when the preliminary feeding began, was: Lot 1, 715; Lot 2, 760; Lot 3, 605; Lot 4, 545; Lot 5, 450 lbs.

The gains during the preliminary period varied much: Lot 1, 25; Lot 2, 265; Lot 3, 165; Lot 4, 150; Lot 5, 236 lbs. This inequality did not continue in so marked a degree.

In the eight weeks from Oct. 31 to Dec. 26 there was some variation in the feeding—shelled corn being fed for three days at the last and no cottonseed given for last five days. The table shows results as to each lot.

| | Gain | Corn Meal | Cotton Seed | Grain per lb. gain | Gain per day |
|---|---|---|---|---|---|
| Lot 1. | 595 | 2476 | 1761 | 6.14 | 2.66 |
| Lot 2. | 610 | 2456 | 1140 | 5.09 | 2.72 |
| Lot 3. | 520 | 4115 | | 7.91 | 2.32 |
| Lot 4. | 455 | 2026 | 1033 | 6.72 | 2.03 |
| Lot 5. | 495 | 2400 | 355 | 5.56 | 2.22 |

While accuracy of the scales used was not absolute it is believed there was no material error from this source. The rate of gain is good and the gain per pound of grain very good. The lot having corn meal only used more grain for each pound of gain than either of the others. The lot having only small quantity of cottonseed made next to best showing.

During four weeks from Dec. 26 to Jan. 23 all the steers were fed shelled corn as exclusive grain food, except that, by mistake, about seven pounds of cottonseed for each steer was fed during last few days of the period. This counted as corn in total feed.

| | Gain lbs. | Shelled Corn | Lbs. Grain per lb. gain | Grain per day |
|---|---|---|---|---|
| Lot 1. | 320 | 2228 | 6.81 | 2.85 |
| Lot 2. | 190 | 2268 | 11.93 | 1.69 |
| Lot 3. | 295 | 2128 | 7.21 | 2.63 |
| Lot 4. | 260 | 1736 | 6.61 | 2.32 |
| Lot 5. | 245 | 1732 | 7.06 | 2.18 |

The showing is a good one except for Lot 2. No explanation can be given for the small gain made by this lot.

For the five weeks, Feb. 13 to March 20, Lots 1 and 2 were fed corn; Lot 5, younger and lighter steers corn and bran. Neither lot made large gains, ranging from 1.28 to 1.37 lbs., per day, but Lot 5 used but 10.53 lbs. grain for each pound gain, while the others used over 13 lbs. for each pound gain.

For the 23 weeks, Oct. 31 to April 10, the daily gain per steer per day was: Lot 1, 2.19; Lot 2, 1.63; Lot 3, 1.84; Lot 4, 1.67; Lot 5, 1.78. For the three weeks following, up to May 1 the rate of gain of all the lots was unsatisfactory, probably because of warmer weather and the practical necessity of letting the steers have access to a small pasture affording enough grass to unfavorably affect their appetite for dry food.

## EFFECT OF DEHORNING.

Eleven of these 20 steers were dehorned Nov. 11. Three days afterwards these eleven showed average loss in weight of 11 pounds in weight, while those not dehorned showed average gain of 15 pounds. One week later the recently dehorned steers showed average gain of 30 lbs., the other nine of 21 lbs., thus showing an apparent average loss of 17 lbs from dehorning. No one of the dehorned steers was "off feed" at any time.

## FEEDING COTTON SEED.

No injury has been found from feeding cotton seed to any class of cattle, although it has not been fed to young calves. In the case in which it has been sole grain food the gains have not been satisfactory. Feeding moderate quantities, say four pounds per day per steer in connection with corn or Kafir has given satisfactory results. Great differences have been noted in the readiness with which different steers ate the seed, some not seeming to like it at any time if they had access to grain.

## GAINS ON PASTURE.

The rapid improvement in appearance and in weight of cattle in thin flesh when turned on good pasture has led many to overestimate average gains. Oklahoma native grasses are palatable and nutritious. With favorable weather the "short grass region" keeps cattle in fair health throughtout the winter. But flies and hot weather come early in the season and tend to retard growth. If there be summer drouth there is little gain.

In no case have the gains on good upland prairie pasture on the Station farm been large for any long period. Partly this is to be explained by the fact that in all cases the Station cattle were in good flesh when put on pasture. The gains made by different lots of steers during the summer are given above.

May 1, 1899 a small bunch of cattle were put on pasture. Up to June 14, 55 days, they had made gains as follows: Jersey bull 90 lbs.; yearling steer, fat, 50 lbs.; two young cows 35 lbs.; two calves 65 lbs.

At suggestion of Board of Regents two well fattened two year old steers, ready for market, were placed on pasture. They made less gains than yearlings; as they did when fed through the next winter. Oklahoma may not be ready to produce "baby beef," profitably, but it is better to sell fat native two year olds rather than keep them for another year.

A supply of green food, corn, sorghum, Kafir, alfalfa or cowpeas with which to supplement the pastures in August and September is desirable.

### VARIATION IN GAIN.

A half-Jersey steer, about one year old was fed during the winter of 1898-9, showing remarkable variations in gains in equal periods. For first four weeks, although not "off feed" at any time, he gained only 10 lbs., eating 282 lbs. of Kafir meal and 114 lbs. cotton seed. For next four weeks the gain was 60 lbs., with 408 lbs., Kafir; next 65 lbs., next 35 lbs., with 448 lbs. Kafir in each period.

A young cow made gain of 115 lbs., in four weeks, 95 lbs in second, 110 lbs., in third period of same length, and then fell to gain of 10 lbs, in next two weeks at which time she was sold.

### PIGS ON PASTURE.

April 27, 1899 eight pigs were divided into two lots, one weighing 250 lbs., the other 270 lbs. They were placed in alfalfa plats of about one-half acre each, one lot receiving no other food, the other full feed of Kafir meal or shelled corn.

During five weeks the pigs with no food but alfalfa made gain of 61 lbs., or 15.25 lbs., each. For next three weeks, to June 22nd, they gained only seven pounds, less than two pounds each. While there was a good stand of alfalfa and the season was favorable for its growth, the four pigs, averaging 80 lbs., each kept it well eaten off.

The four pigs full fed grain with the alfalfa gained 199 lbs., in five weeks or practically 50 lbs., each in 35 days. In next three weeks they gained 125 lbs., or nearly one and one-half pounds per day.

With this last was a sow with a litter of pigs. She gained 61 lbs., in first five weeks, when she was removed, her five pigs gained 146 lbs., in first five weeks and 96 lbs in next three weeks. A young boar in same lot gained 46 lbs., in 26 days, and 29 lbs., in next three weeks.

There was fed to all the pigs in this plat 1688 lbs., corn and Kafir. They made total gain in eight weeks of 764 lbs., using only 2.21 lbs. grain, in addition to the alfalfa for each pound of gain. Counting the small pigs with the others the grain eaten was less than three pounds per day each.

Obviously the grain feeding was profitable. Possibly equal or greater profit might have resulted if only partial feel of grain had been given.

The plat pasturing the pigs with grain feed carried at least one-half more stock than the other, but the alfalfa remained green and fresh.

Six young brood sows, with pigs, were kept during same period on a small native grass pasture with access to a very small quantity of the droppings and waste from feeding the work teams. They gained 50 lbs., in five weeks, and 90 lbs., in next three weeks. The sow which had been full fed grain on alfalfa pasture during May, was put in this pasture June 1 and lost 11 lbs., in three weeks. This trial illustrates the fact that our native grasses will enable pigs to make some gain during the early part of the season. They become less palatable as the season advances.

## WEIGHT AND GAIN OF YOUNG PIGS.

At different times the weights of litters of pigs have been taken weekly. In no case had the pigs more than ordinary care and no great gains have been recorded.

The average weight at birth of litters from sows of different breeds was: 2.44 lbs., 3.05 lbs., 2.6 lbs., 2.25 lbs., 2.43 lbs., 2.7 lbs., 2.77 lbs., 2.75 lbs., 3.07 lbs., each; general average 2.65 lbs.

The weights of six litters at seven days old were: 4.25 lbs., 5.3 lbs., 4.6 lbs., 5 lbs., 5.6 lbs., 4.05 lbs., each; general average 4.8 lbs.

The weights of nine litters at 28 days were: 13 lbs., 13 lbs., 11 lbs., 13.8 lbs., 8 lbs., 11 lbs., 13 lbs., 13.8 lbs., 12 lbs. each; general average 12.1 lbs.

The average weights of nine litters at 56 days were: 32 lbs., 21.7 lbs., 23.3 lbs., 23.75 lbs., 22 lbs., 24 lbs., 23.8 lbs., 25.2 lbs., 18.4 lbs., each; general average 23.8. lbs.

In nearly all cases the typical "runt" was found in each litter.

A case of unusually rapid gain in hog feeding was that of a mature high grade Duroc-Jersey sow, thin in flesh from suckling pigs. For the six weeks from Jan. 16 to Feb. 27, 1899 she made gain of 135 lbs., a little over three pounds per day, being fed 708 lbs. Kafir meal, or 16.85 lbs., per day, using 5.24 lbs., meal for each pound gain. Not all of this was eaten as more than usual waste occurred. In next four weeks she made gain of 60 lbs., as did smaller sow put in pen with her, or 2.14 lbs., each per day, using 5.73 lbs. meal for each pound gain.

## GAIN OF PIGS FOLLOWING CATTLE.

The gain made by hogs getting the waste food from cattle is much less when the cattle are fed meal instead of ear or shelled corn or unground Kafir. Five pigs having access to droppings of a lot of steers full fed on corn and Kafir meal gained only 195 lbs., in 56 days or 39 lbs. each. In another case five pigs gained 100 lbs., in 56 days. In a third case six moderate sized sows gained 245 lbs., in 56 days, a little less than three-fourths of a pound each per day. While these gains are small they are worth saving. The difference between profit and loss in feeding cattle often depends on the use made of the food wasted or undigested by them.

## COMPARISONS OF CORN AND KAFIR.

Six pigs averaging about 135 lbs., weight at beginning of trials ate 2,482 lbs. Kafir heads in six weeks, making 280 lbs. gain or 1.11 lbs. each per day. This is one pound gain for about 6.65 lbs grain.

Three pigs averaging 220 lbs., ate 728 lbs. corn and Kafir meal in 24 days, making gain of 130 lbs., or 1.8 lbs. per day each, using 5.6 lbs., meal for one pound of gain.

Two young sows, averaging 125 lbs., ate 640 lbs., ears corn in 35 days, making gain of 107 lbs., or 1.53 lbs., per day each. Counting the ear corn equal to 529 lbs., shelled corn they used 4.94 lbs., corn for each pound gain. In the next two weeks they ate 258 lbs., Kafir meal, gaining 28 lbs. or one pound per day each, using 9.21 lbs., meal for each pound of gain. This is the least satisfactory gain made in any trial where Kafir was fed.

Four pigs averaging 105 lbs., ate 987 lbs., Kafir meal in 35 days, gaining 170 lbs., or 1.21 lbs., per day, using 5.08 lbs., meal for each pound gain. In next two weeks they ate 212 lbs., shelled corn, soaked, gained only 30 lbs., using 7.07 lbs., corn for each pound. For next four weeks to June 26, 1899, they were fed soaked shelled corn with a daily supply of green alfalfa. Noticeable increase in gain resulted. They ate 511 lbs., corn, making gain of 140 lbs., using 3.65 lbs., corn for each pound gain. This is a striking illustration of value of alfalfa in connection with grain feeding in summer.

Four pigs averaging 170 lbs., ate 685 lbs., corn meal and 300 lbs. ground wheat of poor quality in 30 days, gaining 181 lbs., or 1.5 lbs., per day each, using 5.44 lbs., meal for each pound gain.

### FATTENING PIGS ON FORAGE CROPS.

August 23, 1898, nine pigs belonging to the same litter except one, were put in a pen and fed ear corn preparatory to feeding forage crops. The pigs were farrowed February 28, 1898, weaned at about two months old, put on pasture for the summer and fed some corn meal to keep them growing. They were divided into three lots each, containing three pigs. They were fed the same kind of grain, ear corn until October 17, corn meal from October 17 to 24 and Kafir meal from October 24 until December 5.

Until October 10 the pigs were in permanent pens and the forage was cut green and carried to them. From this date the pigs were in movable pens where they could harvest the crops themselves.

PIGS FED ON GRAIN AND FORAGE CROPS.

| | WEIGHT OF LOT | | GAIN OF LOT | | FEED | |
|---|---|---|---|---|---|---|
| | First | Last | | Daily | Forage | Grain Per Lb. Gain |
| PERIOD I—Six Weeks | | | | | | |
| Lot 1 | 195 | 327 | 132 | 3.14 | Sugar Beets 1-22 a | 3.47 |
| Lot 2 | 200 | 340 | 140 | 3.33 | Cowpeas 1-20 a | 4.55 |
| Lot 3 | 195 | 259 | 64 | 1.52 | Sorghum 1-26 a | 8.94 |
| PERIOD II—Five W'ks | | | | | | |
| Lot 1 | 327 | 420 | 93 | 2.66 | S. Potatoes 1-18 a | 4.75 |
| Lot 2 | 340 | 447 | 107 | 3.03 | Peanuts 1 15 a | 4.29 |
| Lot 3 | 259 | 327 | 68 | 1.66 | Cowpeas 1-9 a | 6.75 |
| PERIOD III—3 Weeks | | | | | | |
| Lot 1 | 420 | 475 | 55 | 2.62 | S. Potatoes 1-30 a | 6.07 |
| Lot 2 | 447 | 503 | 56 | 2.66 | Peanuts 1-25 a | 5.96 |
| Lot 3 | 327 | 393 | 66 | 3.14 | Peanuts 1-18 a | 5.05 |

The gain per day was small in all cases. Striking differences in apparent value of the different forage crops are shown.

## FARM TEAM WORK, FOOD, DRINK, COST.

A pair of mules are kept on the Station farm doing all kinds of farm work. They are eight or nine years old and have weighed from 1980 pounds during the busiest part of the season to 2240 pounds in the winter. They are kept on dry feed throughout the year.

During the year 1898 the team worked 2148.5 hours, an average of a trifle more than 7 hours a day for each work day. They were fed 41 bushels of Kafir corn, 73 bushels of Indian corn, 43 1-2 bushels of oats and 455 pounds of bran. Kafir or Indian corn stover was fed about six months of the year and alfalfa and prairie hay the remainder of the year.

The Kafir was fed ground and the Indian corn in the ear. Counting Kafir 20 cents per bushel ground, Indian corn 20 cents per bushel in the ear, oats 25 cents per bushel and bran 60 cents per hundred, the cost of the grain fed to the team was $36.40.

During December the amount of Kafir stover fed was about 1400 pounds. Estimating that there were four tons of stover worth $2 per ton and four and one-half tons of hay worth $4 per ton fed during the year, the cost of roughage would be $26; making a total cost of feed for the year of about $62. This is 17 cents per day and about three cents as cost per hour for food.

The food and water used by this pair of mules and a pair of horses used on the Station farm was noted for two weeks during the spring of 1899. Each pair averaged about 2130 lbs. weight. They were at moderate work except on Sundays and one or two rainy days. The horses had an average of 30.6 lbs. ear corn, and 31.6 lbs. of Kafir stover, and drank 107 lbs. of water per day. The mules had 23.4 lbs. ear corn. 40.5 lbs. stover and drank 107 lbs. water per day. The mules did about one-third more work than the horses, ate less corn, more stover and drank more water. Not all the stover was eaten by either pair. There were marked variations in the quantity of water drank. One mule averaged nine pounds daily more than the other; one horse five pounds. Temperature much affected the quantity drank. Each of the horses and one mule drank 100 lbs. or more of water in one day. When idle the quantity fell as low as 18 to 20 lbs. per day in three cases.

In a time of hot weather in August, 1898, the water fed to the pair of mules was weighed for eight days. They were idle two of these days, reducing the average working time to less than seven hours per day. They drank an average of nearly 113 lbs. each of water daily. One day the pair drank 350 lbs.; another 307 lbs. In three of the five days they averaged less than 100 lbs. water each.

## SHEEP FEEDING.

Sixteen grade Shropshire wether lambs were fed Kafir heads, with prairie grass hay and corn stover for 13 weeks in winter of 1898. They kept in good condition but made small gains—295 pounds or a trifle over one-fifth of a pound per day. They ate 1624 lbs., Kafir heads. A wether lamb made gain of 13 lbs., in four weeks, or .46 lbs., per day. A Shropshire ram lamb gained 17 lbs., in same time or .6 lbs., per day. They ate two pounds Kafir meal each day, with "crab grass" hay.

The wether lamb and three rather inferior yearling wethers which had been used in digestion experiments, made gain of 86.5 lbs., in 52 days or .41 lbs. per day each. They ate 504 lbs., Kafir grain, using 5.82 lbs., for each pound gain.

## WEIGHT OF LAMBS.

The table gives weights of lambs at ages specified. They were dropped from March 16 to April 30, 1899. The weights of two pairs of twins and of two single lambs are given. They are pure bred or high grade Shropshire.

| Age | No. Lbs. | | Age | No. Lbs. | | Age | No. Lbs. | Age | No. Lbs. |
|---|---|---|---|---|---|---|---|---|---|
| Birth | 10 | 10 | Birth | 7 | 7 | Birth | 9 | Birth | 9 |
| 7 | 14 | 13 | 7 | 11 | 11 | 7 | 14 | 7 | 13 |
| 14 | 18 | 17 | 14 | 15 | 13 | 15 | 19 | 14 | 20 |
| 21 | 22 | 20 | 21 | 19 | 17 | 23 | 24 | 22 | 22 |
| 28 | 27 | 25 | 29 | 25 | 20 | 30 | 30 | 29 | 25 |
| 35 | 32 | 29 | 36 | 31 | 22 | 37 | 35 | 36 | 30 |
| 42 | 35 | 32 | 43 | 33 | 25 | 44 | 40 | 43 | 40 |
| 49 | 40 | 38 | 50 | 33 | 28 | 51 | 42 | 50 | 45 |
| 56 | 43 | 41 | 57 | 37 | 31 | 58 | 49 | 57 | 49 |
| 63 | 49 | 43 | 64 | 42 | 33 | 65 | 53 | 64 | 53 |
| 70 | 55 | 48 | 71 | 45 | 37 | | ... | | |
| 77 | 59 | 51 | | ... | ... | | ... | | |
| 84 | 65 | 54 | | ... | ... | | ... | | |
| 91 | 67 | 60 | | ... | ... | | ... | | |
| 98 | 70 | 72 | | ... | ... | | ... | | |

## WHEAT CULTURE EXPERIMENTS—1898-9.

G. E. Morrow and J. H. Bone.

The tests were made, as in previous years, on the medium upland prairie soil of the Station farm—the same tracts being used as in 1897-8. The land on which the variety tests were conducted had been manured in the winter of 1895, and had the roots and stubble of a crop of cowpeas plowed under in September 1898. Except where otherwise stated the other experiment plats had been manured in summer of 1898 at rate of about 16 tons coarse stable manure per acre.

*Varieties.* Thirteen varieties, with one or two exceptions grown on the farm for the last four years were used in the variety test, having been selected from a much larger list as being most promising. The seed used was that of the crop of 1898 and was of light weight. All the plats were sown at rate of five pecks per acre, Sept. 19 or Sept. 21, except Turkey which was sown Sept 29. The land was plowed Sept. 10 after a crop of cowpeas, following wheat had been removed. The seeding was done with a press drill, rows six inches apart. The wheat came up well in six days. The first heads appeared from May 7 to 11. The wheat was cut June 12—except Turkey. The wheat was thrashed June 22.

Three plats each of Fulcaster and Red Russian were sown as check plats. There was a difference of four bushels in yields of these plats, the average yield of the three of Fulcaster was 25.8 bu., the Red Russian, 23.3 bu. These averages are taken for these two varieties.

The average yield of the 13 varieties was 22.6 bu. Only the Turkey yielded less than 20 bu. per acre. The five varieties giving largest yields were: German Emperor, Fulcaster, Sibley's New Golden, Red Russian and Early Ripe. The average weight per bushel was about 59 lbs., varying from 58 lbs. to 60 lbs. The straw varied in height from 38 to 43 inches, and as cut, from 1870 to 3333 lbs., per acre. All varieties stood up well.

The yields of the different varieties, yields of straw per acre, also the average yields for last four years for the varieties tested during this time are given in table.

| Yields | Bu. Grain 1899 | Lbs. Straw 1899 | Bu. Grain 1896-1899 |
|---|---|---|---|
| German Emperor | 27.9 | 3,333 | 28.6 |
| Sibley's New Golden | 27.2 | 2,332 | 30.7 |
| Fulcaster | 25.8 | 2,339 | 27.7 |
| Early Ripe | 23.8 | 2,365 | 26.9 |
| Red Russian | 23.3 | 2,416 | 27.3 |
| New Red Wonder | 23.1 | 1.969 | ... |
| Nigger | 22.9 | 2,365 | 29.8 |
| Fultz | 22.9 | 2,035 | 26.6 |
| Mo. Blue Stem | 21.1 | 2,100 | 30.3 |
| Early Red Clawson | 21.1 | 1,870 | 29.1 |
| Pickaway | 20.3 | 2,079 | 28.4 |
| Big English | 20. | 2,101 | 28.8 |
| Turkey | 14.7 | 1,738 | .... |
| Average | 22.8 | 2,334 | 28.5 |

The best yielding varieties for the last four years are: Sibley's New Golden, 30.7 bu.; Mo. Blue Stem, 30.3 bu.; Nigger, 29.8 bu.; Early Red Clawson, 29.1 bu.; Big English, 28.8 bu.; German Emperor, 28.6. bu. Fultz and Early Ripe are the only ones in the list with an average yield of less than 27 bu.

The variety called Turkey or Red Turkey has been highly praised but the results were not satisfactory. In addition to the plat in the variety test two other plats were sown on one of the rotation plats, sown Oct. 1. One was sown with seed obtained in the vicinity; one with seed from the U. S. Department of Agriculture. The latter gave yield of 20.5 bu., the other only 13 bu., a difference hard to be accounted for.

### TIME, QUANTITY AND METHOD IN SOWING.

The series of experiments tried in former years was repeated. Thirty-two plats were sown with Red Russian wheat at intervals between Sept. 1 to Nov. 15; the quantity of seed varying from three to eight pecks per acre, some of the plats being rolled before sowing in addition to being harrowed.

The superiority of early sowing was shown in an unusual degree. In some years good crops have been obtained from sowing late in November but late sowing in fall of 1898 was invariably unsatisfactory. No marked differences were found from sowing at four dates in September, and fair yields were secured from sowing Oct. 5. With one exception no plat sown after this date gave yield of more than 12.5 bu., and most were much below this.

The marked decrease in yield and in quality of the wheat from later sowing is shown in following summary: Twelve plats sown in September gave average yield of 28.7 bu., with average weight of 58.5 lb., per bu. Eight plats sown Oct. 5 and Oct. 15 gave average yield of 21.5 bu., with average of about 55 lb. per bu. Twelve plats sown in November gave average yield of 5.4 bu., with average of about 45 lb., per bu.

As a whole rolling somewhat increased the yield but not in any marked degree.

The largest yield was from plat sown with five pecks per acre. In no cases did the yields from sowing three or four pecks equal those from sowing five or six pecks. In the later sowings eight pecks gave largest yields, as might be anticipated as the late sown wheat does not stool so readily.

Four plats were sown with Fulcaster wheat, the seed varying as follows. One plat seed of full weight from exceptionally good crop of 1897; the others with seed from crop of 1898, one plat being sown with the largest kernels; one with second grade kernels and one with the wheat as it came from the thrasher. There was little difference in the yields; that from the seed of 1897 crop being slightly smallest. The second grade kernels gave same yield as the first grade.

### TIME AND METHOD OF PLOWING—MANURE AND NO MANURE.

Six plats, wheat stubble were plowed July 29; two each at following depths: 4 in., 8 in., 8in., and subsoiled to 15 in. Three were manured with stable manure; three left unmanured. Plowing 4 in. deep gave somewhat smaller yields than deeper plowing. No gain came from subsoiling over plowing 8 in. In each case manuring greatly increased the yields. Two plats were plowed 8 in. deep Sept. 3, one manured, one not. The yields were noticeably smaller than from earlier plowing the two yielding an average of 16.8 bu., while the two plowed at same depth in July gave average yield of 23.1 bu.

The four manured plats gave average yields of 27.5 bu., the unmanured 14.5 bu.

An equally striking illustration of the value of manuring was shown in the case of yields on two half-acre plats devoted to continuous culture with wheat. Wheat has been grown on both plats for seven years. In fall of 1898 one-half acre was manured with about 15 tons per acre. All other treatment was as nearly the same as was practicable. The manured plat gave yield at rate of 30.6 bu., the unmanured 12 bu. per acre. Manuring here increased the yield two and one-half times.

Two plats lying side by side were manured, one with stable manure, the other by turning under the stubble and roots of a moderate crop of cowpeas. The former gave 23.2 bu., the latter 16.3 bu. per acre. The yields in both cases were unexpectedly small but the gain from stable manure was marked.

Fifty-eight plats, including a number purposely sown to illustrate loss from late plowing or other undesirable practices, and excluding only the late sown plats, gave an average yield of 22.67 bu per acre. This is about ten bu. above the average yield of wheat in the United States in a series of years.

All experience at this Station emphasises the importance of increasing the supply of decaying vegetable matter in our upland prairie soils. It is believed the gain comes more from improving the physical condition of the soil and its relations to moisture than from the addition of direct plant food in the manure.

The result of this year's trials confirm the conclusions that, with reasonable management, wheat culture is profitable on Oklahoma prairie soils; that no one variety has been found greatly superior to all others; that five pecks per acre is a safe quantity to sow per acre and that sowing in September is safer than at any later time, aside from the valuable pasturage secured from early sown wheat.

## DESTRUCTION OF INSECTS.

A part of the duties of the Station entomologist is to answer inquiries in regard to the name, nature and methods of destroying injurious species of insects. It is a part of his business to keep posted on the various methods that are being tried for the destruction of insects and at the same time make original investiations. The Station is ready at all times to furnish information on the latest and most practical methods of insect destruction. It is often the case, however, that from the nature of the insect, it is impossible to recommend any method whereby an insect may be destroyed and at the same time preserve the substance on which it feeds; the grain louse for example.

The Station has no mysterious means to be employed against insect ravages and it is often the case that the best thing that can be done is to turn to some common means that nearly everyone has at hand or may have at a minimum of expense and trouble. It is advisable to read catalogues of insecticides and spraying apparatus which if intelligently used often save many times their cost. It often happens that an insect appears without any previous warning and although a man might be disposed to purchase insecticides and apparatus, before he could get such things half way home his crop might be devoured and he would have to wait for another crop and another horde of insects before his apparatus would yield any returns.

The old saying that procrastination is the thief of time was never more applicable than in the destruction of injurious insects. A single instance will illustrate. A grape grower in the territory discovered the rose chafer coming from a grass field onto one corner of his vineyard. They came in numbers sufficient to have done considerable damage. He immediately had them picked off the vines by hand twice a day for several days or as long as they continued to come and thereby saved his vines with but little damage. This shows that one should exercise vigilance and watch over what he is trying to grow.

Fowls of all kinds destroy many insects. We have in the territory a thick, heavy beetle commonly called June bug or peach eater. In regions where figs are grown it is called the fig eater. It is on hand when the Alexander and other early peaches are ripening and attacks the best specimens sometimes eating everything but the stone which it leaves hanging on the tree. Poisoning it is out of the question. Hand picking would be tedious. Putting a paper sack over each peach would be two expensive. One farmer in the territory noticed that the beetle is dull and stupid in the very early morning. He trained his flock of turkeys to follow him to the trees in the early morning where he with a pole would jar the beetles off the trees and they would pick them up. They soon even learned to do their own shaking and picking so that the farmer could take his morning nap while the good work was going merrily on.

One of the best animal friends the Oklahoma farmer has is the little horned toad. He thrives, like the insects on which he feeds, in dry weather when the crops are almost at a standstill. An investigation showed that the stomach of one specimen contained 235 chinch bugs besides several caterpillars and other insects.

There are often sent to the Station eggs closely stuck together into a mass about five-eighths of an inch long and half as high of a grayish color. These are the egg masses of the "praying mantis" or "devil's rear horse," an insect that has an ugly appearance and should be let alone as the only prayer it offers is for more insects such as plant lice to devour. The egg masses are often found on the branches and twigs of fruit trees and too often, through ignorance of their nature, destroyed.

The Station often receives specimens of brown scale-like objects arranged on a twig in one or two rows close together and so that one overlaps the next about half way. They somewhat resemble broad flax seeds. They are the eggs of the common katydid and will do but little harm. They are often suspected to be the San Jose Scale but each one is about twenty times as large as a scale of this kind.

E. E. BOGUE.

## DISEASE AMONG HORSES.

In the early part of September, 1898, numerous inquiries reached the Experiment Station regarding a very fatal disease among the horses in Kingfisher, Garfield and Grant counties. Soon after the first inquiries were received, the disease assumed the form of an epidemic extending to a considerable portion of the counties named and to a less extent into Woods, Kay and Blaine counties.

The first appearance of the disease was reported from Sheridan in the eastern part of Kingfisher county. The first deaths occurred about September 1,, and for a time the disease in Kingfisher county appeared to be confined to this locality and on bottom pastures, but by September 10th animals were dying on upland pastures over a considerable area of country. There is in the section of country where the disease was most prevalent very little low land or timber, the greater portion of the country being a high, level prairie with very little low land along the streams.

Two visits were made to this part of Oklahoma in September. The first locality visited was Sheridan where the disease was first reported and it was found to be present over that portion of the county between Sheridan and Hennessey, a large number of farmers having lost stock or had sick animals at the time.

It was a very noticeable fact from the beginning of my inquiries that the disease was confined to farm animals. On making inquiries among the liverymen and other stock owners of Hennessey, Enid and Waukomis, I found they had not lost any horses from the disease, although their feed, and hay especially, was purchased from the surrounding country. This led to a close examination of the pastures where the disease was most prevalent. The principal grass of a large part of western Oklahoma is Grama grass (*Bouteloua oligostachya*) which makes a valuable pasture. In a large number of pastures examined the seed of the grass was largely replaced by smut (*Ustilago boutelouae*). It was so abundant that after a light rain the grass would be colored black with the smut. This smut was present in large quantities in all pastures examined where the Grama grass was found. It was also noticed that in pastures closely grazed there was no disease as the grass did not mature seed. As the Grama grass was replaced by other grasses in the northern part of Garfield county the disease disappeared, but from all information the disease was prevalent in the southern part of Grant county.

No other cause could be assigned for the disease except the excessive quantity of smut found on the grass as no losses occurred where the smut was not found or among horses that were not pastured. There is a small amount of smut present every season, but when it exists in such quantities as found last season, stock should not be allowed to graze on the pastures until they have been mowed and the grass tops destroyed, or until late in the season after heavy rains have washed out the smut.

Where opportunity offered, treatment was tried using large doses of potassium bromide and chloral, using atropine when indicated and applying cold packs to the head. This treatment was successful in many cases, but usually the disease assumed a very acute form giving little opportunity for treatment.

In many cases the animal would not live longer than six to twelve hours after the first symptoms, but animals were seen that had been sick from three to six days.

Partial paralysis of some parts of the body was usually noticeable; seen most frequently in the hind limbs and where the disease continued for several days this would become so complete that the animal would be unable to rise. Only one sick animal was seen that was violent and very few cases were reported. The most common course of the symptoms was a staggering gait at first; the animal if left alone would walk in a circle or would stand with head drooped or pushed against the wall of the stall or manger. When unable to stand longer, they remained lying quietly allowing the head or feet to remain in any position in which they were placed. In one violent case seen, the animal was unable to stand and spasms followed every few minutes lasting for a few seconds. This continued for about an hour when the animal died. In an adjoining stall was another sick animal lying perfectly quiet, apparently sleeping most of the time and would allow the head or feet to remain in any position. Breathing was very slow and stertorious.

Three postmortem examinations were made. The internal organs of all were fully examined but no variation from normal noticed. The only changes found were in the brain and medulla. In two cases examined, the base and coverings of the brain were congested and a small quantity of bloody serum surrounded the brain. In the third postmortem, the membranes of the brain were congested with a small amount of serum present around the brain and the medulla.

The symptoms and postmortem examinations all indicate that the disease was inflammation of the brain and its covering, or cerebro-spinal meningitis.

L. L. LEWIS.

# SUMMARY OF RESULTS OF EXPERIMENTS.

John Fields.

## INTRODUCTION.

The increased interest in the work of the Station is resulting in a demand for information contained in bulletins that are now out of print and has made it necessary that this information be summarized and published in some form. It has been thought better to treat the work of the Station by topics rather than by departments since much of the work on investigations is done by two or more departments working in conjunction. Accordingly, under each subject will be found the results of work done. All of the work of the Station is not reported but only such portions as have led to some result, either positive or negative, of a practical and scientific character. This plan serves to eliminate much distracting matter and will, it is believed, place the work of the Station in its proper light before the people. Full details of any of the experiments here reported will be gladly furnished by correspondence. The Station, because of limitations imposed by the law establishing it, is prevented from undertaking many lines of inquiry considered by some very desirable. Operating as it does under an act of Congress which prescribes the manner of expenditure of the funds from the national treasury and for the proper accounting of the same, the Station alone can determine what is the proper work for it to do. The work has been made as broad as possible as the following summary will show.

## WHEAT.

1. *Variety tests.* Tests of varieties of wheat have been conducted continuously since the establishment of the Station and the results reported in five bulletins, Nos. 8, 12, 20, 28, and 36.

In 1893, 254 varieties were tested, the following being the highest yields secured: Silver Chaff, 24.0; Michigan Amber, 24.0; Missouri, 20.7; Currell, 20.3; Mediterranean, 19.3; Mennonite, 18.3 bushels per acre.

In 1894, 50 varieties were tested in duplicate on manured and unmanured land. The average yield of the two plats for the best varieties was the following: Nigger, 27.9; Nebraska, 26.8; Currell, 26.4; Velvet Chaff, 26.4; Silver Chaff, 23.8, Missouri, 22.4 bushels per acre.

In 1895, the wheat crop was a failure and no results were obtained.

In 1896, 71 varieties were tested. The best bearded varieties yielded as follows: Hybrid Mediterranean, 29.5; Nigger, 29.5; Mo. Blue Stem, 27.5; Sibley's New Golden, 27.3; Dietz Longberry, 27.0 bushels per acre. The best smooth varieties yielded as follows: Michigan Amber, 28.0; Early Red Clawson, 21.8; Fuller's German Emperor, 20.0; Badger, 19.7 bushels per acre.

In 1897, 64 varieties were tested, the following being the highest yields secured: Fultz, 57.0; Red Russian, 51.3, Mo. Blue Stem, 45.7; Sibley's New Golden, 51.0; Dietz Longberry, 50.0; Oregon Swamp 50.0 bushels per acre. The yields in this experiment were remarkable and are summed up as follows in Bulletin No. 28, June, 1897. "The eighty-three plats gave an average yield of 39.6 bushels per acre. Eight plats gave yields between 50 and 57; fourteen between 45 and 50; twenty-four between 40 and 45; fifteen between 35 and 40; twelve between 30 and 35; and eleven less than 30 bushels per acre. The smallest yield was at rate of 19.5 bushels."

In 1898, 54 varieties were tested. "The largest yields were: Early Red Clawson, 35.2; Big English, 34.5; Fultz, 33.4; Fulcaster, 32.2; Red Russian, 30.0 bushels per acre." (Bul. 36.) "Of these, the three last named were among the best in the yields in 1897 and are counted as desirable as any tested."

While it is true that these results are local and do not give a complete estimate of the value of the different varieties for all parts of the Territory, it is not probable that a variety that has continuously failed here would be a success in other localities. The following summary of results taken from Bulletin No. 36 contains a list of varieties which have done best at the Station, any one of which might give the highest yield in certain sections.

"For the two years 1897 and 1898, the followinw varieties have given average yields of over 40 bushels per acre—taking the yield from the best plat in each case: Fultz, 45; Red Russian, 42; Fulcaster, 41. The following have given average yields of from 35 to 40 bushels: Early Red Clawson, Big English, Missouri Blue Stem, Sibley's New Golden, Mealy, Crate and Lebanon. The following from 30 to 35 bushels: Dietz Longberry, Nigger, Bearded Monarch, German Emperor, Extra Early Oakley, Longberry, Miami Valley, Early Ripe, Saskatchewan, and Valley. With two or three exceptions, each of these varieties gave relatively good yields in 1896."

2. *Preparation of soil.* Trials in 1897 resulted in but little difference

in yield on subsoiled and un-subsoiled plats and in 1898 "no perceptible benefit came from rolling the land in addition to harrowing it before seeding."

In 1894, comparisons were made of 51 varieties grown on duplicate plats with and without manure. Twenty loads of fresh stable manure (from horses) were applied to the acre and plowed in a few days before seeding. The average yield per acre for the manured land was 32.4 for the un-manured, 14.4 bushels per acre.

3. *Quantity of seed.* In 1896, "no important difference in yields came from sowing widely differing quantities of seed per acre, especially in fairly early seeding. A plat sown at rate of three pecks per acre gave nearly as large a yield as one sown at rate of eight pecks per acre."

In 1897, "the best yields were from plats sown at the rate of six pecks per acre, but the largest yield from one plat was from sowing at rate of five pecks per acre. In some cases there was no great difference in yield, whether three or eight pecks per acre were sown."

In 1898, "plats were sown at intervals at rate of 3, 4, 5, 6 and 8 pecks per acre." The average yield increased with the thicker seeding and thick seeding is considered safest in unfavorable seasons.

4. *Time of seeding.* In 1893, seeding beginning October 10th gave better yields of grain than seeding from November 14th to 24th.

The results of trials in 1894 led to the following advice: "Sow wheat as early as possible after September 1st. Put it 'in the dust' if you have no rain."

In 1896, "In special trial of different dates of sowing, there was a steady decline in yield from sowing October 1st up to December 10th."

In 1897, the largest yield was from sowing September 15th and nearly as large from sowing September 25th. Good yields were obtained from sowing October 5th, but later sowing gave still smaller yields.

In 1898, "neither very early nor late sowing proved best; generally the best yields were from sowing September 25 to October 5th."

These experiments, taken as a whole, indicate that higher yields may be expected from wheat sown from September 15th to October 5th than from that sown either earlier or later. The character of the season and the condition of the soil will modify these limits which are not to be taken as absolute.

5. *Feeding wheat.* Bulletin No. 13, issued in December, 1894, at a time when low prices led to the feeding of wheat to farm animals, summarized what was known of the subject at that time. The matter was of but temporary interest and served a useful purpose when it was issued.

6. *Spring wheat.* Three varieties tested in the spring of 1892 yield-

ed as follows: Wellman, 8.2; Blue Stem Velvet Chaff, 7.7; Saskatchewan, 6.1 bushels per acre.

### CORN.

The experience and observation of the Station extending through a period of seven years show that, in general, corn should be grown on the bottoms and Kafir on the upland. In the experiments mentioned later, seasons have occurred when corn on the bottoms yielded 50 bushels or more per acre while that on the upland was not worth the husking.

1. *Variety tests.* Tests of varieties of corn were reported in Bulletins No. 10, 21, 33, and 36. There is great confusion in the naming of varieties, the same one frequently being known by several different names in different localities. The tests show that seed should be selected from the best yielding varieties in the neighborhood where the corn is to be grown. Plants become adapted to the climate and locally grown seed will be found to give better results, in the long run, than any imported seed. Careful selection of perfect seed-corn by each farmer will improve the crop and usually be found most satisfactory.

Cornucopia, or "seven eared" corn was tried in 1898 and yielded less than 15 bushels per acre. "Brazil Flour corn" gave a yield of 21 bushels per acre which was less than half the yield obtained from a locally grown, medium early, white variety.

2. *Preparation of soil.* Deep plowing is preferable in all cases. Comparisons of land plowed four inches with that plowed eight inches deep resulted in the latter giving the higher yield. The deeper plowing permits the soil to take up the rain that falls and to hold it for the needs of the crop when dry weather comes.

3. *Drilling or listing?* In 1896, drilled and listed corn were planted side by side, one plat of each per week from March 21st to April 25th. The drilled corn, with but one exception, yielded better than the listed. The average yield of the plats drilled with the corn planter was 14 per cent greater than that of the listed plats.

4. *Time of planting.* This must of necessity vary with the character of the weather. In 1898, beginning March 28th, plats were planted each week until April 25th; also one on May 13th. The largest yield was from the first planting, the next from the third. Aside from this, there was a steady decrease in the yield with later planting, except that planting May 13th gave a larger yield than planting three weeks earlier. In former years, differences in time of planting did not give corresponding differences in yield.

In this, as in most other cases, it is not possible to lay down a fixed and unalterable rule. Individual judgment and experience must be brought to bear in deciding when to plant each season's crop.

5. *Thickness of planting.* Results of experiments are reported in Bulletins No. 21, 33 and 36. In 1897, a trial was conducted on bottom land, the corn being planted at different distances in rows 3 ft. 8 in. apart. The smallest yield of corn was 46 bushels per acre, the stalks being 6 inches apart in the row; the largest, 63.5 bushels, with two stalks each 30 inches; the next largest, 62 bushels with one stalk each 18 inches.

A duplicate of this experiment was conducted on upland, but on account of dry weather, no well-developed ears were produced and none of the corn was husked.

In 1898 on upland, the best yields were from planting at the rate of one kernel each 12 inches in rows 3 ft 8 in. apart. The yields averaged less where the rows were three feet apart.

6. *Cultivation.* Experiments in frequency and depth of cultivation have not been conclusive but indicate that a small number of shallow cultivations is sufficient in ordinary seasons. In 1898 the kind of implement used seemed to make little difference and a plat cultivated twice gave a larger yield than those cultivated even nine times.

## KAFIR CORN.

The experiments summarized under this heading refer only to the production of Kafir corn, the thrashed grain.

1. *Variety tests.* Four varieties have been tried: Blackhulled white Kafir, white Kafir, red Kafir and Black Rice corn. The first might more appropriately be called "black-husked" white Kafir, as the grain is white and but little different from that of white Kafir, the husks of which are white. These two varieties have squared-ended heads carrying their width well toward the base. The heads of red Kafir are longer, looser, and more branching than those of the white variety; the grain is dull red in color. Black Rice corn is classed as one of the Kafirs and has smaller heads than the other varieties.

Trials conducted during the seasons of 1896 and 1897 showed that either of the white varieties yielded better than the red on the Station farm. Accordingly, in the experiments of 1898, only the black-hulled white variety was grown.

2. *Time of planting.* Experiments covering this point indicate that Kafir may be planted later than corn, due regard being taken of the character of the season. In 1897, planting on May 15th and 22nd gave

yields of 38.2 bushels per acre; planting on April 17th and May 1st yielded 22.3 bushels. In 1898, planting on May 13th and 24th gave higher yields than planting on April 4th, 11th, 18th, 25th or on June 3rd.

3. *Thickness of planting.* Experience has shown that Kafir should be planted closer than corn. In 1897 with stalks three inches apart in rows three feet apart, a yield of 53.3 bushels was secured. Higher yields were secured from rows three feet than from rows either 30 or 44 inches apart, the plants being the same distances apart in the rows in each case.

These results were corroborated in 1898 when four plats with rows three feet apart and one stalk to each four inches gave an average yield of 85 bushels per acre. Ten plats, with one stalk to each 8 inches and rows three feet apart yielded 45 bushels per acre. Greater distances gave decreased yields.

It is believed that for average upland soils, Kafir should be planted in rows three feet apart with one stalk to each three or four inches when the crop is grown for the grain that it will produce.

4. *Corn or Kafir which?* It depends upon where and for what purposes the grain is to be grown.

On bottom land when the crop is to be sold as soon as matured, plant corn. It is always a marketable article at some price, depending usually on the volume of the local supply. If the grain is to be fed to stock, it would seem advisable to replace a portion of the corn by Kafir, especially for the large amount of rough forage which the latter affords.

On upland, corn is not a sure crop while Kafir has not yet, even in the dryest seasons, failed to yield well. In 1897, when dry weather, high temperature, and hot winds affected the corn so that no well-developed ears were produced, Kafir planted alongside yielded from 25 to 53 bushels of grain per acre. In 1898 when corn did well, Kafir surpassed it on upland, one plat yielding at the rate of 102 bushels of Kafir corn per acre.

On bottom land, plant corn or Kafir; on upland, plant Kafir.

## CASTOR BEANS.

This crop is increasing in importance and is rapidly taking its proper place as one of many crops, rather than the one crop, which should be grown.

1. *Time of planting.* In 1897, the largest yield, 12.9 bushels per acre, was from planting on April 13th, but planting as late as May 19th gave 10.4 bushels. There was a corresponding difference in time of first picking, the earlier planted plats being ready on July 21st; the later on

August 17th. In 1898, planting on April 8 gave 11.4 and on April 29 and May 13th, 11.3 bushels per acre.

2. *Thickness of planting.* Trials in 1897 indicated that one plant every 15 to 18 inches in rows 42 to 48 inches apart was thick enough. In 1898, the best yields were from planting in rows 3 feet apart with one stalk each 9 to 12 inches.

3. *Selection of seed.* The beans usually grown are all "castor beans" no varieties being distinguished. Well-formed spikes from plants carrying the largest number of good blooms should be selected while gathering the crop and kept separate for the next year's seed. Unless this is done, the character of the seed, on which so much depends, will be poor and give an irregular stand with many worthless plants. Careful selection of seed, on the other hand, will improve the stand, the yield, and the quality of the crop. In one trial covering this point, a gain of two bushels per acre was obtained by planting selected seed.

4. *Poisonous properties.* No part of the plant is available as food for animals. Many cases have been reported where horses ate of the beans and almost invariably died. The exact cause of death has not been determined but in the opinion of the Veterinarian of the Station, the beans contain some quick-acting poison. No trouble has been experienced from animals eating other parts of the plant.

## OATS.

Variety tests of oats were reported in Bulletins 4, 16, and 33. In 1897, the following yields were obtained: Texas Red, 49.4; Negro Wonder 43.5; Black Russian 33.2; Lincoln, 31.8 bushels per acre. This is the same order in which these varieties yielded in 1896.

## ALFALFA.

Ever since the establishment of the Experiment Station, an effort has been made to find some crop for hay. Grasses have been repeatedly tried, tenderly nursed, and so far proven unsuccessful. Clovers, white, red, and alsike, have had a great deal of attention but none have done so well as to give promise of permanently paying yields of either hay or pasturage. While a few grasses and clovers have shown some adaptability, none can yet be depended upon to yield a paying crop when sown on any considerable area. None of them, in so far as experience at the Station goes, can be sown with any degree of certainty that a ton of hay per acre will be obtained.

Alfalfa, on the other hand, has been proven to be reasonably well-adapted and to give yields of hay up to three or more tons per acre. In 1897, an acre of alfalfa on the upland Station farm gave 6055 lbs. of well-dried hay at three cuttings. Good yields were also obtained in the season of 1898 and alfalfa on the Station farm in the spring of 1899 is in excellent condition.

1. *Character and preparation of the soil.* Alfalfa has a long taproot and will not do well on soils with hard-pan close to the surface. As a general rule, the better the land has been cultivated and the deeper it has been plowed and subsoiled, the better will alfalfa thrive. Land that has been in corn, Kafir or cotton and yielded good crops is usually fitted for the production of alfalfa. Subsoiling, when practiced, should be done long before sowing to allow the soil to settle and become reasonably firm.

2. *Time of sowing.* The seed may be sown either in late summer, fall or spring. Good stands and failures may be expected any of these times, depending on the weather conditions after the plants come up and while they are young and delicate. Trials at the Station have resulted in successes from sowing twice in early August and on three occasions in the spring.

3. *Hay or pasture.* When a good stand of alfalfa has been secured, it is a permanent improvement to the farm if it is properly managed. The plants, once established, continue becoming stronger and live for a number of years.

Alfalfa should be cut for hay when in about full bloom and requires more care in making than does prairie hay. The leaves are easily broken off when dry and contain much of the nutritious material of the plant. The curing and stacking of alfalfa hay is an art to be learned by experience and observation; the stacks should be protected by a covering of prairie hay or straw. Three cuttings may be secured, one in May, one in June, and one at a later period depending on the rainfall and temperature.

Failures with alfalfa are reported frequently. Is it not possible that a large proportion of these failures is caused by too close pasturing? There is no question but that alfalfa is good for hogs but it is not so clear that hogs are good for alfalfa. Many fields of alfalfa are ruined by too close pasturing. The crowns of the plants are injured by animals tramping on them and cropping them too closely. The plant is weakened and dies and "alfalfa has failed." The Station has conducted no experiments on the effect of pasturing alfalfa but has noted the effect in many sections of the territory. This observation has led to the belief that alfalfa should be regarded mainly as a hay crop and only incidentally as affording pasture.

Rough places covered with native grasses should not be broken out but fenced and used for the latter.

4. *Feeding alfalfa hay.* The uses to which alfalfa hay is put where it is grown extensively, and its composition indicate its proper place in the economy of the farm. It is a rich feed containing more of the muscle-making nutrients than any of the coarse fodders or prairie hay. It should be fed in conjunction with corn and Kafir fodders and with corn and Kafir meals. With them, it makes more nearly what is called a "balanced ration" for growing and milk producing animals; a ration which is nearer to their actual needs than one composed exclusively of corn or Kafir products.

### COWPEAS.

Realizing that some easily grown and nutritious forage crop was needed in Oklahoma, the Station for a time conducted co-operative experiments with cowpeas and encouraged their culture. The general results of these experiments were satisfactory, and showed that cowpeas do well in many sections of the territory. The following brief summary of methods of growing and using cowpeas is taken, for the most part, from Farmers' Bulletin No. 89 of the U. S. Department of Agriculture.

1. *Cultivation and Harvesting.* "Cowpeas are planted broadcast or in drills, very commonly between the corn rows after the crop is laid by. The amount of seed varies from four quarts to 2 bushels per acre, the average amount being, perhaps, about three pecks. The seed will stand being covered to the depth of 2 or 3 inches, but care must be taken to plant when the ground is neither to wet nor too cold, as the peas rot very rapidly under such circumstances. It must be remembered that this plant originated in the Tropics and that when transplanted to higher latitudes it makes its best growth in the hottest weather. Where the vines are grown for hay, the yield will be larger if the seed is planted in drills and cultivated a time or two."

"The vines should be mown for hay when the peas are well-formed and the leaves and pods are first beginning to turn yellow. After wilting on the ground or in windrows from twenty-four to forty-eight hours, the hay is placed in small, thin piles, or cocks, and allowed to cure for several days, when it may be carted to the barn or stacked under sheds. The haymaking process is a difficult one, requiring more care and attention than in the case of red clover, because the broad leaves and thick stems contain a large amount of water. The hay must be placed in cocks before the leaves become brittle, and the piles must be small enough to allow free circulation of air to the center of each. Bright cowpea hay, clean and well-cured, is worth as much as the best red-clover hay. The hay is frequently stacked in the field and covered with straw or grass for protection."

"The bush varieties are the best for hay, because of the greater ease with which they may be mowed and handled." The yield of hay varies from two to four tons per acre depending on the fertility of the soil and method of growing. "Its feeding value is equal to that of the best red clover, and the hay ranks high in palatability and digestibility."

2. *For swine and cattle.* "When cowpeas are planted for green manure, it is an excellent practice to turn hogs into the field about the time the first peas are ripening. Young pigs thrive amazingly on the succulent foliage and well-filled pods, and the quality of pork raised on such a healthful and nutritious diet is very fine. This is a profitable method of fattening hogs or of preparing them for topping off with corn or sorghum for market. An acre of ripening cowpeas will pasture from fifteen to twenty hogs for several weeks, and the gain in fertility from the droppings of the animals during that period will more than counterbalance the fertilizing value of the forage eaten. The rapid increase in weight will thus represent so much clear profit, and the farmer is richer by half a ton or more of prime pork for every acre planted. Chickens and turkeys also eat the ripe peas and do well upon them.

Cattle and horses are sometimes pastured on them, but the safer and more economical way of feeding the green cowpea vines to such stock is to cut or pull and feed partially wilted. There will be less waste and destruction from trampling, and if each animal is given only so much as it can eat clean, the greatest economy as well as the greatest profit will result. Furthermore, cattle and sheep are liable to bloat if allowed to eat too ravenously of cowpea vines or any other rich and succulent forage, and by using it as a soiling crop the danger may be more readily controlled and the loss prevented."

3. *Harvesting the seed.* "The majority of farmers harvest only enough seed of cowpeas to plant again next season. The ripe pods are picked by hand and are stored in barrels until needed or are thrashed out by machine. The yield per acre varies according to the variety and method of cultivation. Eight to 12 bushels is a fair average of the amount that can be obtained when the peas are planted in the corn rows. Sown alone, broadcast or in drills, yields of from 20 to 35, and even in rare cases, 50 bushels are obtained. The Black, Unknown, Red Ripper, Clay and Calico varieties are all heavy seed bearers. The Black-eye, Red Crowder, and

Whip-poor-will or Speckled, are very widely cultivated and find ready sale."

### STOCK MELONS.

Stock or "pie" melons grow readily and afford a large yield of stock food with but little trouble. An analysis reported in Bulletin No. 25 showed that they contain 93 per cent of water anl that one ton of melons contains about as much real food material as 525 pounds of green corn fodder, or 235 pounds of corn stover (fodder after husking.)

### SUGAR BEETS.

1. *For sugar making.* Experiments, in co-operation with the U. S. Department of Agriculture, were conducted during the seasons of 1897 and 1898, and are being continued this season.

The results of two season's work are summarized as follows:

1. It has not been found that beets of sufficiently high grade for sugar manufacture can be grown on a commercial scale in Oklahoma.

2. During the season of 1897, 21 samples were analyzed representing 11 counties. They showed a mean percentage of sugar in the juice of 12.0 and a mean co-efficient of purity of 65.3. But one sample contained more than 12 per cent of sugar in the juice with co-efficient of purity of 80, which is the standard for sugar manufacture. A sample representing another county was analyzed at Washington; the percentage of sugar in the juice was 12.4 and the co-efficient of purity 72.5.

3. During the season of 1898, 19 samples were analyzed representing 10 counties. They showed a mean percentage of sugar in the juice of 9.4 and a co-efficient of purity of 67.6. As in 1897, there was but one sample of sufficient purity and richness for sugar manufacture.

4. Combining the results of 1897 and 1898, 41 samples representing 14 counties have been analyzed, showing a mean percentage of sugar in the juice of 10.8 and a mean co-efficient of purity of 66.5. Of the 41 samples examined, but two were of a quality suited to sugar manufacture.

2. *For stock feeding.* Yields of 20 tons per acre of sugar beets have been secured. They make excellent feed for cows and are much relished by them during the winter months when coarse forage is dry and not very palatable. It is not thought, however, that it would be found profitable to grow them extensively for this purpose. For a change of feed or an addition to dry forage, they are of value.

### FRUIT ON THE STATION FARM.

Early in the history of the Station, an extended series of tests of varieties of fruits was planned and begun. Seven years have elapsed since the first start was made, yet the time has not been sufficient to permit the making of the positive statements frequently demanded of the Station by fruit growers and others. It is yet too early to state with certainty what many varieties will do in this climate. Deductions based entirely on the results secured at the Station are not of as certain value as when supported by observation of the methods employed at different places in the territory and the results produced. The Station is working on this subject and hopes, after observing and studying the work of a few more years, to issue a reliable and trustworthy report on the fruit industry of Oklahoma.

In the brief notes that follow will be found a portion of the record of the work with fruit. Measurements of the circumference of the trunks of the trees, one foot from the ground, are given as an imperfect estimate of the general vigor of growth of different varieties. The orchard has had clean cultivation with the exception of an occasional crop of cowpeas late in the season.

## APPLES.

The following varieties of apples fruited in 1898: Broadwell, Cannon Pearmain, Cole's Quince, Crawford, Hockett's Sweet, Keswick Codlin, Lowell, Late Strawberry, Maiden's Blush, Moon, Mammoth Black Twig, Nansemond Beauty, Pomeroy, Talman's Sweet, Wagener, Water, Yopp's Favorite.

The following varieties of apples set fruit in 1899: American Summer Pearmain, Alexander, Arkansas Beauty, Arkansas Black, Bledsoe, Black Annette, Carolina Watson, Cullen's Keeper, Crawford, Cole's Quince, Domine, Dickinson, Early Ripe, Fenley, Fallawater, Gano, Hightop Sweet, Ingram, Indian, Jones' Seedling, Kittageskee, King, Kansas Queen, Lowell, Limber Twig, Maiden's Blush, Missouri Pippin, Moon, Nantahalee, Nero, Pyle's Red Winter, Porter, Rambo, Rhode's Orange, Stewart's Golden, St. Lawrence, Twenty Ounce, Talman's Sweet, Wagener, Water, Willow Twig, Yopp's Favorite.

The following varieties bloomed in 1899 but set no fruit: Yellow Transparent, Jeffries, Jewett's Best, Kentucky Red Streak, Shockley, Black Warrior, Chattahoochie, Chester Early White, Family Favorite, Vandevere, Early Pennock, Kinnard's Choice, Lawer, Mammoth Black Twig, McIntosh Red, McMahon, May, Nansemond Beauty, Roman Stem.

Trees set in 1892 that measure more than 12 inches in circumference of trunk: Rhode's Orange, Jewett's Best, Duchess of Oldenburg, Flory's Bellflower, Moon, Maverack, Arkansas Beauty, Arkansas Black, Autumn Bough, Chester Early White, Cullen's Keeper, Early Pennock, Trenton Early, Enormous, Fallawater, Fameuse, Vandevere, Indian, Lawver, McMahon, Minkler, Nickajack, Stewart's Golden, McAfee, Kentucky Red Streak, Ortley Bellflower, Rutledge.

Trees set in 1892 that measure between 10 and 12 inches in circumference of trunk. Early Colton, Early Harvest, May Pippin, White Juneating, Carolina Red June, Large Yellow Bough, Hightop Sweet, Yellow Transparent, Carolina Watson, Kansas Queen, American Summer Pearmain, Nantahalee, Early Strawberry, Keswick Codling, Benoni, Disharoon, Fenley, Duchess, Yopp's Favorite, Maiden's Blush, Hoover, Pomeroy, Porter, Twenty Ounce, St. Laurence, Kittageskee, Alexander, American, Golden Russet, Black Annette, Cole's Quince, Domine, Elkhorn, Jersey Sweet, Forest, Kinnaird's Choice, Mammoth Black, Mammoth Black Twig, Mammoth Pippin, Sweet Dixon, McIntosh Red, Mason's Orange, Nero, Plum Cider, Pyle's Red Winter, Rhode Island Greening, Shackleford, Wagener, White Pippin, Willow Twig, Utters Red, Isham Sweet, English Sweet, Lauren's Greening, White Spanish Reinette, Shockley, Cobbett, Mother, Pewaukee, Rambo, Talman's Sweet, Rebel.

Trees set in 1892 that measure between 8 and 10 inches in circumference of trunk: Red Astrachan, Early Ripe, Charlottonthaler, Cooper's Early White, Fanny, Primate, Northern Sweet, Lowell, Bledsoe, Carter's Blue, Carolina Greening, Bostic Queen, Mrs. Bryan, Ortley, Colvert, Ohio Pippin, Shannon, Tuscaloosa, Celestia, Dr. Walker, Moultrie's Babbitt, Chattahoochee, Clayton, Cornell's Fancy, Crawford, Dickinson, Family Favorite, Gideon, Huntsmans Favorite, Ingram, Jones' Seedling, King, Longfield, Loy, Mammoth Pippin, Marshall Red, May Nansemond Beauty Northwest Greening, Orchard Red, Poorhouse, Pryor's Red, Red Riches, Limber Twig, Romanite Gilpin, Roxbury, Russet, Scarlet Cranberry, Smith's Cider, Water, Stump, Roman Stem.

Trees set in 1892 that measure less than 8 inches in circumference of trunk: Simmon Red, Sops of Wine, Gravenstein, Jeffries, Red Betigheimer, Red Winter Pearmain, Buckingham, Late Strawberry, Rambo, Broadwell, Cannon Pearmain, Eureka, Gano, Osceola, Foundling, White Winter Pearmain.

Trees set in 1892 but now dead: Summer Queen, Stewart, Spencer Oldenburg, Tetofsky, Bailey's Sweet, Rawle's Janet, Mangum, Stevenson, Yates, Bethel, Etowah, Horn, Pickard's Reserve, Royal Limber Twig, Sonoma.

### PEARS.

Trees set in spring of 1895, trunk measuring more than 9 inches in circumference. Forest Beauty, Kieffer.

Trees set in spring of 1895, trunk measuring between 7 and 9 inches in circumference. Beauty, Lawson, Buffum, Early Harvest, L. B. de Jersey.

Trees set in spring of 1895, trunk measuring less than 7 inches in circumference. Buffum dwarf; Clapp's Favorite, Seckel dwarf, Lawrence, Shelton, Duchess dwarf, Barlett dwarf, Clapp's Favorite dwarf, Garber.

Trees set in spring of 1895 now dead. Barlett.

The dwarf Bartlett is the only variety that set fruit in 1899.

### APRICOTS.

The following varieties of apricots were set in the spring of 1892 and are now living. Golden Russian, Gibb, Alexander, J. L. Budd, Peach, Early Golden, Shemsi, New Castle, Luizet, Jackson, Olberg.

The following varieties have set fruit this year: Golden Russian, Gibb, Alexander, J. L. Budd, Peach, Early Golden, Jackson, Olberg.

The following varieties of apricots were set in the spring of 1892, but have died from various causes: Nicholas, Alexis, Roman.

Trees of the following varieties now measure more than 16 inches in circumference of trunk: Golden Russian, Gibb, Alexander, J. L. Budd.

### PLUMS.

The following varieties of plums bloomed in 1899: Weaver, Newton, Wooten, Mrs. Clifford, Forest Garden, Lone Star, Emerson, Wolf's Free Stone, Pottawatomie, Botan, Satsuma, Yosebe, Ogon, Abundance, Burbank, German Prune, Manana, Silver Prune, Passardii.

The following varieties of plums set fruit in 1899: Abundance, Emerson, Manana, Mrs. Clifford, Newton, Ogon, Pottawatomie, Pissardii, Weaver, Wooten, Yosebe.

Trees set in spring of 1895, trunk measuring more than 10 inches in circumference: Lone Star, Yosebe, Burbank.

Trees set in spring of 1895, trunk measuring between 8 and 10 inches in circumference: Shiro Snomo, Manana, Hattakio, Wooten, Mrs. Clifford, Emerson, Pottawatomie.

Trees set in the spring of 1895, trunk measuring between 6 and 8 inches in circumference: Weaver, Newton, Botan, Wolf's Free Stone, Satsuma, Abundance, Pissardii, Silver Prune.

Trees set in the spring of 1895, trunk measuring less than 6 inches in circumference: Ogon, Forest Garden.

### CHERRIES.

The following varieties of Cherries were set in spring of 1895: Early

Richmond, English Morello, Belle De Choisy, Dye House, Montmorency, Olivet.

All of the trees measure between 9 and 11 inches in circumference of trunk. All of the varieties fruited this year.

### NUT BEARING TREES.

The following list of nut trees was set in 1895. A few trees of each variety are still living, but none have borne any fruit. They are arranged in order of hardiness: Black Walnut, Almond Langnedoc, Early Bearing Walnut, Dwarf Prolific English Walnut, English Walnut, Mayette Walnut, Thin Shelled Walnut.

The following list of nut trees was set at the same time and in the same plat with the above list, but none are now living: American Chesnut, Large Spanish Chestnut, Japan Chesnut, Extra Early Paper Shell Pecan, Select Texas Pecan, Butternut, White Filbert, Hazelnut.

### PEACHES.

The following varieties of peaches set fruit in 1899: Alexander, Barnes, Becquetts Free, Bishop, Bell's October, Bonanza, Becquetts Cling, Champion, China Cling, Crimson Beauty, Cobbler, Druid Hill, Early York, Elberta, Gen. Taylor, Heath Cling, Henrietta, Indian Blood Cling, June Rose, Champion Mark, Mountain Rose, Old Mixon Cling, Ringgold, Sylphide, Salaway.

### GRAPES.

In the following list of grapes the varieties are named in order of their relative hardiness and productiveness. The black grapes have shown the best varieties both as to hardiness and productiveness, the white next, and the red last. The best varieties of the white grapes are nearly if not quite as good as the best black grapes.

*Black.* Admiral, Hermann Jaeger, Elsmere, R. W. Munson, Concord, Cottage, W. B. Munson, Norton's Virginia, Mrs. Munson, Black Pearl, Dr. Warder, Clinton, Janesville, Devereaux, Barry, Amanda, America, August Giant, Big Extra, Fern Munson, Carman, Ironclad, Israella, Isabella, Herbemont, Newman, Telegraph, Worden, Wilder, Rogers No. 2, Jacquez, Moore's Early, Highland, Cynthiana, Aminia, Cunningham, Early Wine, Elsinburgh, Hartford Prolific, Herbert, Beacon, Conqueror, Neva Munson, Neosho, Marion, Mary Ann, Montefiore, Rentz, Early Victor, Eumelan, Hermann, New Haven, Mills, Othello, Muench, Marguerite, Lenior, Louisiana, Merrimack, North Carolina, Peabody, Secretary, Whitehall, York, Maderia, Cornucopia, Creveling, Bacchus, Black Hawk, Black Herbemont, Brant, Hopkins, Laussel, Jaeger, Oriole, Bailey, Black Eagle.

*White.* Faith, Elvira, Lady Washington, Martha, Noah, Pearl, Autuchon, Onderconk, Niagara, Wilding, Opal, Mason's Seedling, Moore's Diamond, Green Mountain, Gold Coin, Golden Gem, Empire State, Prentiss, Rommel, Grein's Golden, Hayes, Naomi, Humboldt, Jessica, Irving. Etta, Eva, El Dorado, Duchess, Uhland, Taylor, Pocklington, Transparent, Gov. Ross, Antoinette, Bell, Campbell, Centennial.

*Red.* Northern Muscadine, Dracut Amber, Perkins, Norfolk, Lutie, Wyoming Red, Catawba, Woodruff's Red, Brilliant, Amber, Amber Queen, Delaware, Goethe, Massasoit, Iona, Lindley, Ulster Prolific, Dr. Collier, Vergennes, Walter, Lindherbe, Venango, Diana, Beauty, Berckmans, Elvicand, Perry, Iowa Excelsior, Peter, Wylie, Poughkeepsie, Requa, Challenge, Brighton.

## ANALYSES OF WATERS.

The character of the water supply has so much to do with the health of any community that it merits great attention. The chief factors which determine whether or not a given water is fit to drink are the quantity and character of the dissolved mineral matter which it contains and the nature and source of the organic matter. The mineral matter depends on the character of soil through which the water percolates before it is drawn for use. The amount and character of the organic matter is to a great extent, affected by local contaminating influences.

1. *Mineral matter.* More or less complete analyses have been made of the mineral matter contained in 162 samples of water. The samples secured represent nearly every county and condition of the soil. Further work has not given cause to change the following statement made in Bulletin 29, September 1897. "It may be said, in general, that good water is obtainable in almost every part of Oklahoma. There are a few localities where more or less difficulty is experienced, but care in digging the well is frequently repaid by a supply, small at times, of good water. The mistake of going deeper for water is sometimes made with the result that it is secured but that the whole supply is unfit for use. If the first water struck is good, and there is a fair amount of it, digging should be stopped, especially in localities where bad water is frequent. A second well may be dug if the supply is insufficient."

2. *Organic matter.* Epidemics of typhoid fever are frequently traceable to organic contamination of the water supply and this contamination is usually due to carelessness which no amount of analyzing the water will remedy. Attention was called to this in an early Bulletin (No.

7, July, 1893) and the following advice concerning location of wells was published. "Do not invite pollution by locating a well near a cess-pool or barnyard. I found a few wells very poorly walled and some very badly located, and in one or two instances the location could not have been worse had the question been carefully studied. Those of you who have not permanently located your buildings would do well to first find a supply of good water—I believe it can be obtained—then build near the water." "Should the water have a disagreeable smell after having been kept in open or closed vessel any considerable length of time, something is radically wrong and the source of pollution should be immediately looked up and removed without delay."

The importance of keeping the water of wells and springs free from organic contamination cannot be to strongly urged as it is from this source that much sickness comes. Insects, toads, mice, rats, and rabbits have a way of getting into wells that is at times past finding out but they can be kept out by properly curbing and covering the well. No amount of covering will prevent drainage from getting into the well which should in all cases be at least 100 feet from, and on higher ground than, any possible source of refuse from the house or barn.

3. *Waters for irrigation.* Much work has been done on this subject and two bulletins have been issued. The following summary from Bulletin No. 38 gives the conclusions which have been reached:

"1. The water of the Salt Fork of the Arkansas and of the Cimarron river is unfit to be used for irrigation except in very limited amounts.

"2. The water of the North Canadian and of the South Canadian may be safely used for irrigation.

"3. None of the smaller streams that have been examined, except the Black Bear, are unfit to be used for irrigation.

"4. Well waters vary greatly in the amount and character of the dissolved mineral matters which they contain and should be analyzed before being arranged to be used for irrigation.

"5. A partial survey of the conditions which must be met in the construction of reservoirs for the retention of storm river waters has been made and it is not clear that this method is entirely feasible in all cases."

Correspondence should always be had with the Station before sending samples for analysis as certain precautions in sampling must be observed to make the results trustworthy.

## FEEDING CORN AND KAFIR.

1. *Introduction.* The general trend of results of feeding trials with

Kafir products is that it requires more Kafir than it does of Indian corn to produce a pound of live-weight. In an experiment with pigs at the Kansas Station (Bul. 53.) it was found that 5.15 lbs. red Kafir meal were required to produce a pound of gain while 4.38 lbs. corn gave the same result. In each case, the pigs were given all they would eat and while those fed Kafir meal gained 1.37 lbs. per day, those fed on corn meal gained 1.7. lbs.

Another trial at the same Station (Bul. 61) gave even more marked results in favor of corn meal, 3.96 lbs. of which gave a pound of gain against 6.21 lbs. of Kafir meal. The pigs fed corn meal made an average daily gain of 1.44 lbs. while those fed Kafir meal gained but one-half pound per day. An experiment in fattening heifers is also reported in the same bulletin. It is concluded "that red Kafir corn meal is not quite equal to corn meal for fattening cattle, though the difference in favor of corn is less marked than in the case of the hogs."

In another trial at the Kansas Station (Bul. 67) three lots of steers were fed corn meal, red Kafir meal, and white Kafir meal, respectively, making gains of 1.86 lbs., 1.71 lbs., and 1.78 lbs. per head. To produce a pound of gain in weight it required 9.97 lbs. of corn meal, 10.86 lbs., red Kafir meal, or 10.41 lbs. white Kafir meal. The profit from the five steers fed corn meal was $47.60; from the five fed red Kafir meal, $44.98; from the five fed white Kafir meal, $42.02. Hogs followed the steers during the experiment and made gains which bring the profit from the feeding of corn meal up to $54.70; red Kafir meal to $55.10; and white Kafir meal to $53.23, "which practically places Kafir corn on the same basis as corn in regard to feeding value."

In view of the increasing importance of Kafir in this and similar regions, it is necessary that a definite system of nomenclature be used when speaking and writing of the crop. The following, based principally on current usage among farmers, is used in this report:

*Kafir,* the crop in general.
*Kafir corn,* thrashed grain.
*Kafir heads,* portion bearing grain.
*Kafir fodder,* whole plant above ground.
*Kafir stover,* Kafir fodder minus the heads or grain.
*Kafir meal,* ground Kafir corn.

2. *Digestion experiments.* After a crop has been found to yield well and grow readily, it is most desirable to have a correct estimate of its value. Chemical analyses alone will not furnish a correct basis for this estimate. Feeding trials in comparison with a crop of known value are

practical experiments but are much influenced by the conditions of the experiments. These two, however, in connection with trials of the digestibility of the feeding stuff in question, aid in determining to a great extent the value which should be attached to a crop. With this purpose in view, several digestion trials have been conducted by the Station.

In a digestion trial, weighed quantities of feed are given to animals (usually steers or sheep) and the dung is collected and weighed. Both the feed and the dung are analyzed and from these data the per cent of food digested is determined.

Twenty-two separate trials were made with Kafir products fed to steers. The complete details of the experiment were reported in Bulletin No. 37. The essential results of the experiment may be summarized as follows:

*Kafir stover* contained as much digestible matter as average corn stover.

*Kafir fodder* contained 10 per cent less digestible matter than average corn fodder.

*Kafir heads* contained one-third as much digestible matter as average corn-and-cob-meal.

*Kafir corn* fed in the heads was neither more nor less digestible than when fed after thrashing.

*Kafir corn* fed after soaking in water for twelve hours was less digestible than when fed dry.

*Kafir corn* fed dry contained 40 per cent less digestible matter than coarsely ground Kafir meal.

*Kafir meal,* coarsely ground, contained 20 per cent less digestible matter than average corn meal.

*It paid to grind Kafir corn*—One hundred pounds of Kafir meal contained as much digestible matter as one hundred and sixty-seven pounds of Kafir corn.

*A gain of thirteen per cent,* in the amount of digestible matter was secured when Kafir fodder was thrashed, the grain ground and fed to steers along with the shredded stover from the fodder.

*A gain of less than two per cent* in the amount of digestible matter was secured when Kafir fodder was thrashed, and the resulting Kafir corn fed to steers along with the shredded stover from the fodder.

### DIGESTION OF KAFIR CORN BY STEERS.

The following comparison of the composition of Kafir corn before and after having passed through the digestive tract of steers shows the slight extent to which the small, hard grains are affected during the process.

Composition of Kafir corn.

Water-free substance.

| | Ash. | Protein | Fiber | N-free ex. | Ether ex. |
|---|---|---|---|---|---|
| As fed dry | 1.30 | 12.72 | 1.82 | 81.00 | 3.16 |
| After digestion, A | 0.83 | 11.73 | 1.65 | 82.34 | 3.45 |
| B | 0.81 | 13.60 | 1.76 | 80.78 | 3.05 |
| C | 0.85 | 12.54 | 1.69 | 82.00 | 2.92 |
| D | 0.74 | 11.04 | 1.74 | 83.95 | 2.53 |
| Average, A. B. C. & D | 0.81 | 12.23 | 1.71 | 82.26 | 2.99 |

Water-free substance.

| | Ash. | Protein | Fiber | N-free ex. | Ether ex. |
|---|---|---|---|---|---|
| As fed soaked | 1.37 | 13.11 | 1.88 | 80.13 | 3.51 |
| After digestion, A | 0.78 | 12.85 | 2.24 | 80.73 | 3.40 |
| B | 0.77 | 12.49 | 1.70 | 81.51 | 3.53 |
| Average, A. & B | 0.78 | 12.67 | 1.97 | 81.11 | 3.47 |

Calculated to organic matter, we have the following composition for Kafir corn fed dry, before and after digestion:

| | As fed. | After digestion, | Difference. |
|---|---|---|---|
| Protein | 12.88 | 12.33 | —.55 |
| Fiber | 1.84 | 1.72 | —.12 |
| Nitrogen-free extract | 82.08 | 82.94 | .86 |
| Ether extract | 3.20 | 3.01 | —.19 |

In the same manner, the organic matter of Kafir corn after soaking for 12 hours has the following composition, before and after digestion:

| | As fed. | After digestion | Difference. |
|---|---|---|---|
| Protein | 13.32 | 12.77 | —.55 |
| Fiber | 1.91 | 1.98 | .07 |
| Nitrogen-free extract | 81.21 | 81.76 | .55 |
| Ether extract | 3.56 | 3.49 | —.07 |

# Reprints From the Ninth Annual Report.

1899-1900.

## MEANS OF PREVENTING TEXAS FEVER*

*L. L. Lewis.*

The subject assigned has a double interest to stockmen in Oklahoma because we are situated on the dividing line between the infected and non-infected territory. Large areas of the territory that are below the quarantine line are free from infection and cattle raised on such pastures are susceptible to Texas fever, and so in moving our native cattle from one locality to another a certain per cent becomes infected and may die from this cause.

To first consider the importance of preventing fever among our native cattle, it is of primary importance to recognize the cause of the disease. It is not my purpose to discuss this side of the question but in connection with my subject I will state that so far as any experimental evidence is concerned, the tick is the only means in nature of conveying the disease from one animal to another and in the absence of the tick there is no Texas fever. By pasturing on ground that is free from infection there is no danger of cattle dying from Texas fever. This means is not always possible in infected territory and requires more care and attention than most men will give it in order to make it successful, but if this method is carefully followed out there can be no danger of loss, but the slightest negligence in the way of introducing an infected animal into such a pasture would soon infect the pasture and probably most of the cattle in the pasture. This method of placing cattle (susceptible animals) on pastures free from infection and keeping the animals from coming in contact with infection is the only means of absolutely preventing Texas fever. Such a method of handling cattle will not produce immunity and is of little value as far as the general distribution of cattle among stockmen is concerned.

The Missouri Experiment Station conducted some experiments to determine the protective value of blood serum from southern cattle when inoculated into susceptible cattle, but so far as practical results are concerned in giving protection to susceptible cattle, the results were negative.

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*Address at meeting of Oklahoma Live Stock Association, El Reno, February 15, 1900.

It appears that experimentally the only way to produce immunity is to produce a mild form of the disease either by infesting the animal with ticks or by inoculation with a small quantity of the blood from an immune animal which will contain the miscro-parasite causing the disease. The method of producing immunity by tick infestion is not as reliable in its general results as could be desired and will hardly be practiced to any extent as more accurate and trustworthy results can be obtained by using the blood from a southern animal.

If tick infection is used at all it should be practiced in the late fall as the disease will assume a much milder form at this season than at any other time of the year, and if the infection is mild the disease may be controlled to a certain limit.

The recent publication of a bulletin from the Texas and Missouri Experiment Stations has added new interest to the method of producing immunity by blood inoculation as the record of a number of tests made in a commercial way is given. The fact that the inoculation of immune blood into susceptible animals promises to be a valuable remedy to prevent a fatal form of Texas fever in animals shipped south should not cause anyone to regard the method as being safe under all conditions or one that can be successfully carried out by every one who undertakes the work. There are certain essential things to observe in connection with blood inoculation and to neglect any of them is to cause a possible failure in the entire work. From work already reported it is certain that cattle from seven to twelve months old are to be preferred. This age or even as young as six months is preferable to bring south regardless of the method to be used in rendering them immune. Whether they are to be turned on infected pastures late in the season and receive no further attention or if they are to be infected artificially with ticks or to be inoculated with blood, the young cattle are to be preferred to mature stock.

The method of securing the blood and injecting it into the cattle are details easily understood by those familiar with similar work. The effect of the inoculation in a majority of cases is to cause a mild form of the fever but in some the fever may prove fatal. The effect of the inoculation to render the animal immune to fever cannot be compared to the effect of vaccinating to prevent black-leg in cattle.

In the latter case no noticeable symptoms follow the operation while in the former every symptom of the fever is seen and the calves will often require every attention and frequently medical treatment in order to resist the disease. After the cattle are inoculated with blood they should be well cared for for a year and if possible exposed to a light tick infestion the first summer.

Inoculation may be performed at any time of the year but in our climate the best results will probably be obtained by inoculating during the winter or spring and giving the cattle some extra attention the first summer. They may be inoculated either before or after being shipped south but the latter method I think will be preferable, allowing the calves to become accustomed to their feed and surroundings before they are inoculated.

Further work along this line will probably change to some extent the details of the work but the method in the present stage offers every inducement to the southern breeder to ship to the southern stock farm and ranch the best breeds of cattle found in the north.

# HOG CHOLERA.

### *L. L. Lewis.*

Swine diseases do not assume the same importance in Oklahoma as they do in some of the northern and central states where hog raising is developed to a much greater extent but these diseases are of as great importance to the individual stock raiser in Oklahoma as in any other locality. As Oklahoma develops in agricultural resources it is probable that hog raising will be one of the best developed industries with the general farmer.

It is not the intention of this article to discuss at length any of the new remedies or cures for hog cholera but to describe briefly the cause and nature of the disease, how to recognize it and how to use such means of prevention as are in the reach of every farmer.

Whenever a fatal outbreak of disease occurs among swine it is reasonably safe to assume that it is either hog cholera or swine plague, or both as the two diseases are frequently found to exist in the same animal, and so far as any ordinary means of controlling the disease is concerned any method suitable for controlling hog cholera will answer equally well for swine plague. The diseases not only resemble each other in symptoms during the early stages but they are both caused by bacteria and the disease can only be checked by such means as will prevent exposure to the germs causing the disease, or that will destroy the bacteria after the hogs are infected. Hog cholera is generally more prevalent than swine plague and in mixed infections the symptoms of hog cholera are more pronounced than those of swine plague.

The first symptoms of the disease are generally not sufficiently pronounced to enable any one to say whether the disease is cholera or not and in the first appearance of the disease in a herd it frequently assumes an acute form, the animal living from a few hours to one or two days. In such cases a post mortem examination may not enable any one to make a correct diagnosis. In most cases the disease is slower and the symptoms become well marked. The most noticeable symptoms are loss of appetite, a feverish condition accompanied by fits of shivering and an unwillingness to move. The bowels may be normal at first but after one or two days there is a persistent diarrhoea which generally continues throughout the course of the disease. The eyes soon become weak, congested and watery, and later the lids are partly gummed together with a thick yellowish exudate. Coughing is frequently noticed and may become very severe.

Almost a constant symptom where the disease continues for several days is the reddening of the skin in spots on the lower portion of the body, inside of the thighs and under the neck. If the disease is swine plague instead of hog cholera the symptoms of lung disease will be more marked, as difficult breathing and a severe cough.

The duration of the disease may be from a few hours to two or even three weeks. Cholera is very fatal to young pigs and will often attack them when older hogs escape.

The principal organs to be examined in making postmortem examinations are the intestines and the lungs. If the animal has been sick one or two weeks the lesions are apt to be well marked. The intestinal ulcers of hog cholera will be seen in most chronic cases by carefully opening the small intestine where it joins the large intestine. The ulcers are located around the valve between the large and small intestine. These ulcers vary in size, are circular in shape and vary in color from a deep yellow to brown or black. They can be felt on the outside of the intestine as hard solid growths in the intestinal wall. The lymphatic glands in the region of the ulcers are frequently enlarged and firm. In the acute form of hog cholera the membrane lineing the intestines is congested and this is frequently all that can be seen on post mortem.

If the disease is swine plague the principal lesions will be found in the lungs. By cutting into the lungs they will be found to contain a large number of small yellow masses which is dead tissue. Sometimes large masses of yellowish cheesy material will be found. In some place the lungs will be found collapsed with general congestion of the lung tissue.

The bacteria which cause hog cholera grow in the blood vessels and collect in small clumps in the capillaries, plugging them causing the blood to escape into the surrounding tissue. This is the cause of the red condition of the skin and the congestion of the intestines. Small red spots are often seen in the heart muscle, pleura and pericardium from the same cause.

The cause of the disease is a germ or bacteria, the bacillus of hog cholera which causes hog cholera and the bacillus of swine plague which causes swine plague. These diseases do not occur without the presence of these germs and any neglect or bad care the animals may receive does not cause the disease but only lessens the vitality of the animal so they are more susceptible to the disease.

The germ may enter the body by the lungs or by the alimentary canal. The germ of hog cholera most frequently enters the alimentary canal with the water and food while the germ of swine plague causes disease by entering the body through the lungs.

The germs of both diseases can be cultivated in the laboratory and the disease produced in hogs (1) by feeding them the germs (2) by causing them to inhale the germ, or (3) by injecting the germ into the circulation. Animals in infected pens contract the disease by inhaling or eating the germs.

The swine plague germ is easily killed, its vitality lasting under ordinary conditions from one to three months but they may under very favorable conditions remain virulent for a greater length of time. The hog cholera germs are very resistent to destructive agents and retain their vitality for several months unless killed by extreme cold weather. Infected pens should not be used for hogs for a year unless they have been very thoroughly cleaned and disinfected and this is something very difficult to do and practically is never done.

The fact that the cause of the disease is a germ which will live for a considerable length of time makes it possible for the infection to be carried from one farm to another by any animal going from infected pens to healthy pens, by birds, by water running through several farms on some of which the disease exists, or by people passing from one pen to another.

As a means of prevention, hogs purchased from unknown parties or even from adjoining farms should not be placed in the lots with hogs belonging to the farm until they have been kept in separate pens for three or four weeks. Carelessness in this matter is frequently the cause of the loss of almost the entire herd from cholera. Too much care cannot be used in allowing new purchases or hogs from adjoining farms to run in the pens of what are known to be healthy hogs. If a stream runs through the hog lots and cholera appears on farms above, the hogs should not be allowed to drink the water, but fenced away from it and supplied from a well. By exercising such care a considerable loss may be prevented.

Very little can be said in regard to the matter of treatment of sick animals. No treatment has been found that is considered a cure and almost every remedy that has been offered has been tried by hog raisers.

In some outbreaks of cholera the disease is in a mild form and most of the sick animals recover. If in such a case some remedy has been used it is advertised as a cure while the next outbreak may be a fatal form of the disease and the remedy is found useless.

Hogs should be allowed an abundance of green feed during the summer season. This can be secured by growing sorghum or by sowing wheat or other grains for grazing purposes.

# DIVERSIFIED FARMING IN OKLAHOMA.

*John Fields.*

## INTRODUCTION.

Ten years of experience in a new and untried section of country, such as was Oklahoma so short a time ago, has developed and indicated to a great extent its possibilities. The peculiarities of soil and climate are, in a measure, known and understood by those who till the soil, sow the seed, and reap the harvest.

Perhaps the greatest single feature that is most fully recognized is the unusual number and variety of products that may be grown and matured. The farmers who came to the new country were from every state in the union and brought with them knowledge of the crops and methods to which they were accustomed. Farmers from the states north, south and east settled in the same township and the result has been a system of agriculture which is unique in many ways. The nature of the population has been such as to preclude the hazardous system of growing only one or two crops. Exactly the opposite, a wide diversification, has contributed largely to the prosperity enjoyed during the past decade by the farmers of the territory.

In the following pages, the chief features of the present system are recorded and further possibilities are indicated. Certain lines of agricultural industry may be handled best by specialists but for the greatest number, a judicious diversification is desirable.

## CLIMATE.

The climate of Oklahoma is an approximate mean between that of Kansas on the north and northern Texas on the south. In winter, the temperature seldom reaches zero, and in summer, a maximum of 105 is not unusual. The continuous breeze in summer renders the heat less oppressive than in the states north and east. Violent storms are no more frequent than in other sections of the country. The number of cloudy days is small, the records showing nearly 75 per cent of the total possible amount of sunshine during the year.

The rainfall decreases gradually from east to west, but is sufficient in amount for the maturing of crops, varying with the nature of the soil and location. Much of the high land is used to best advantage when the native grasses are pastured or cut for hay. This is true of all parts of the territory. It is equally true that almost any crop may be grown on bottom land in even the dryest sections. And between the moist bottoms and the dry uplands are large areas which yield profitable returns to the farmer when intelligently handled.

## CROPS.

The location and character of the soil should be carefully considered when planning for the crops to be grown. There is probably no single farm in Oklahoma on which all of the crops mentioned in what follows can be grown with profit, yet on every farm, many of them will give profitable yields. Experience and judgment after trials on a small scale must determine what shall be grown. Constant changing and shifting is worse, if any thing is worse, than growing but a single crop. Seeking after novelties and marvelous things usually results in loss. A series of crops that keeps the farm force at work during the whole year is good business and it pays. When this condition is reached and each crop yields a profit, the ideal possibility of farming in Oklahoma has been attained. Farming then is not a combination of spurting and loafing, but is a steady business.

## WHEAT.

History is repeating itself in Oklahoma. Too many farmers are growing nothing but wheat. They did the same thing elsewhere and left when the soil ceased to produce wheat. There is no magic here which will make the result different from what it was there. Continuous wheat growing may not exhaust the fertility of the soils, but it will make them cold and clammy and hard and useless.

There are, however, many mitigating circumstances and Oklahoma wheat growers have had excellent reasons for growing nothing but wheat up to the present time. Money was needed and wheat growing has brought the money. The change from the sod house to the comfortable dwelling has been rapid and tends to inspire increased confidence in the crop that has brought it about. There is perhaps nothing else that would have done it so quickly. The trying period is now happily past—wheat growers have plunged and won. It is now time that they should make their winnings secure.

To do this they need not abandon wheat entirely nor suddenly. A gradual change to a more diversified system should be brought about. In part, this is already being accomplished by the wheat itself. The excellent winter pasture which wheat affords is being partially utilized and the number of cattle is increasing. With these cattle must come other crops for their support and fattening.

Little need be said of methods. Early plowing and early seeding are advised by nearly all and practiced by those who can. The one great mistake that is nearly always made is the waste of manure and straw which so greatly increases the yields when worked into the soil. The city manure pile on the outskirts of one of the principal cities in one of our great wheat counties is a smouldering and, in some respects an impressive pile typical of improvidence and waste.

Many farmers could grow more wheat to advantage and many could grow less. A decrease in the total acreage need not result in a decrease in the total crop and ultimately, will prove of lasting benefit and advantage. It cannot be too strongly urged that strawburning should cease and that the straw and manure should be returned to the land. If this is done, the period of continuous, profitable wheat culture may be greatly extended. If it is not done, experience the world over teaches that the end will soon be reached, no matter what the original fertility of the soil may be.

## CORN.

This great crop is next in importance, perhaps to wheat. In common with wheat, it is a staple crop for which there is always a market at some price. From the nature of the crop, there is little danger to be feared from exclusive corn culture. The corn-grower is usually something of a stockman and feeds a portion, at least, of the product on the soil where it is grown. The character of the crop is such that its profitable culture is safe only on low lying soil. On upland, corn is at the mercy of the weather and lack of moisture at the critical period has in some years resulted in complete failure. On the contrary, corn on the bottoms has not yet failed to be profitable.

Corn matures in August and an increasing proportion of the fodder is cut and shocked each year. Corn stover makes excellent roughage for cattle and the gain by cutting is large. The long period of hot, dry and frequently windy weather following the ripening of the corn destroys nearly all of the value of the fodder if left standing.

Much of the corn that comes to market is badly mixed showing lack of care in seed selection. No other crop is so readily susceptible of quick improvement as corn. Stalks and ears of individual excellence are easily found. The corn-grower should have an ideal type of corn in mind and go through the field when the crop is mature and select the kind of ears that he wishes to perpetuate. Tastes differ but seeds from large ears with small cobs well covered with uniform grains and from stalks bearing tow or more perfect ears is easily secured in this manner. This plan should be the regular method of selection of seed corn. The ears selected should be stored in a cool, dry place, sorted during the brief leisure of the cold weather, and the corn shelled in preparation for seeding. There is no need of paying high prices for seed from distant localities and tales of varieties that will yield, without fail, fifty or seventy-five or one hundred bushels per acre are fables in which the purchaser is left to find the moral.

## COTTON.

A recent inquiry conducted by the Station showed that fifteen acres was the average grown by eighty growers of cotton. This was in Payne, Lincoln and Logan counties. In a few other districts, the average is perhaps larger.

Not every farmer will find it profitable to grow cotton as the crop is one that requires considerable hand labor. Its culture has, however, proven profitable to many and it is an important crop that if rightly used, will be permanently desirable.

Here, as with many other crops, sufficient attention is not paid to the character and purity of the seed. Selection and improvement of cotton-seed is a matter of some difficulty, and requires skill and patience. There seems to be a field here for the work of a few skilled cotton-growers who should have for their object the improvement and development of a type of cotton well-suited to this region. Several varieties of cotton differing widely in character may be developed from a single seed in the course of a few years. This tendency to variation makes the opportunity and the necessity for selection greater than with almost any other crop.

The general plan of improvement consists in the selection of well developed bolls from plants of individual excellence both as to yield and quality of fiber. The cotton so selected should be hand-ginned and a sufficient amount of seed obtained to plant an area large enough to give seed for planting the entire crop the second year. Further selection should be made from the plants grown from the first selected seed and seed thus selected taken to grow the seed for the general crop the third year. The grower who improves his cotton in this manner will find but little difficulty in disposing of the seed from his general crop to others who don't go to the trouble that he does. This steady improvement should be kept up all the time and will result in larger yields of better quality in a very short time.

Cotton should be grown in rotation and not continuously on the same piece of land. It is a crop that draws heavily upon the fertility, and in time impoverishes the soil so that neither it nor other crops will give a profitable yield. If, however, it is grown once in three or four years on a given field, and other suitable crops are grown in the meantime, the soil has time to recuperate and is in better condition for a crop of cotton.

### OATS.

Some modification of our present methods seems yet necessary before the oat crop can be relied upon. Weeds and rust seem to be the greatest difficulties in the way. It is possible to overcome the former in a great measure by sowing oats after one or two clean-culture crops, such as corn and cotton, have been grown on the land. In this way, weeds and grass are partially eradicated and the crop has a chance to cover the ground before they get a start. Early sowing of an early maturing and rust-proof variety is perhaps the surest method of avoiding rust. The Texas Red variety has yielded well at the Station and is preferred by many farmers.

Oats is excellent feed for horses and the crop is desirable in a rotation leaving the ground in good condition to be followed by wheat. The amount grown at present is insufficient for local demands and but little of it is shipped to market. An increased acreage would be profitable in many sections.

### CASTOR BEANS.

The growing of this crop is confined chiefly to Logan, Payne and Noble counties, but almost every county has a small acreage. The extent of the crop in the counties named is due to the fact that it has been grown there for a longer time than elsewhere and probably not because of any special climatic or soil conditions. This crop could perhaps be extended with profit to other sections of the territory. It requires considerable hand labor at picking but no special machinery for cultivation or preparing for market.

The seed should be planted during the latter half of April, the soil having had the same preparation as for corn. The rows should be from 3 to 3 1-2 feet apart with one seed each 12 to 18 inches. Clean, shallow cultivation should be given until the ground is shaded by the plants. After this, no attention is required until the first crop of spikes is ripe. This stage is indicated by the drying up of the seed pods and the tendency of the bean to "pop out." Picking should be begun before the "popping" stage is far advanced. A box is fixed on runners and is drawn between the rows and the picker cuts off the ripe spikes and throws them into the box, taking two rows at a time.

After picking, the spikes are spread on a previously prepared piece of hard soil from which the weeds and grass have been scraped. The piles of spikes are forked over and placed in a thin layer so that they may dry rapidly. The beans "pop out" and may be cleaned by running through a fanning mill. Care should be taken that the beans do not become wet and in case of rain, they should be covered.

Three pickings are usually necessary, and some of the crop is unavoidably lost on the ground during the ripening stage. The seed-pods, or hulls as they are usually called, are equal in fertilizing value to wood ashes and form an excellent mulch and manure for fruit trees.

No part of the plant can be used as food for animals. Horses seem to have a special fondness for the beans and they must not be allowed to eat them. The beans contain a specific poison and horses almost invariably die from the effect of eating even a small amount of castor beans.

The profits from the crop are not large, twelve bushels per acre being an average yield, selling at seventy-five cents to a dollar per bushel. Those who grow it, however, think a small acreage of the crop each year desirable and profitable.

This crop is fully as susceptible of improvement by seed selection as any other. Selected seed on the Station farm produced two bushels per acre more than unselected seed. Large spikes from vigorous plants of individual excellence are easily selected when the castor beans are being picked and kept separate for seed for the next crop.

### KAFIR CORN.

This is a comparatively new crop and one that is practically unknown to eastern farmers. It has much to recommend it to those in Oklahoma who have upland farms and is being largely used by them as a substitute for corn. It is well suited for this purpose. The absence of an outside market for the grain is an advantage rather than a hindrance as it makes stock-raising almost a necessity.

Black-hulled white Kafir is the variety usually grown in Oklahoma, though in Kansas, the red variety is preferred by some. Trials at this Station have resulted favorably for the former.

Kafir when grown for grain should be planted closer than corn. For the average upland soils, it is probably best to plant in rows three feet apart with one stalk each three to five inches. At this distance, yields of from 04 to 85 bushels per acre have been secured on the Station farm.

When grown for the forage, it should be planted much thicker. When grown in this manner, the crop may be cut by hand or by machinery and shocked until used. There are many unanswered questions concerning the best and cheapest methods of growing, harvesting, and feeding the Kafir crop. Farmers have had to feel their way in a large measure, though several of the published bulletins of this and other Stations have reported results of quite extended experiments. It is probably true that on upland soils, more pounds of pork or beef can be produced by feeding the crop from an acre of Kafir than from an acre of corn. This is the case, even though the results of practical feeding and digestion trials have placed Kafir and its products nearly twenty per cent below corn in feeding value. A better understanding of methods of growing and feeding will result in reducing this percentage of difference very materially.

### HAY.

The chief hay crop of the territory is made from the native grasses. None of the true, cultivated grasses have yet shown value for hay here. There are cases in which timothy has taken hold and given a light yield, but generally speaking, it has not succeeded. Little dependence is placed upon hay for feed on farms, and much that is made is marketed in the cities.

There is one hay crop that succeeds in Oklahoma, and that is alfalfa. A large increase in the acreage of the crop is most desirable. In saying that alfalfa succeeds, it is not meant that it will do so on all soils. Very hard, dry upland and very sandy soils are not suited to alfalfa, and while it may be grown on them, yields are light and a good stand difficult to secure. The amount of such land in proportion to the total area is, however, small and there are few farms on which some land may not be well used in alfalfa growing.

### COWPEAS.

This crop, and soy beans as well, is not appreciated and understood as it should be in Oklahoma. Cowpeas take the place of clover and do it well but the crop differs from clover in being an annual.

### SORGHUM.

Sorghum when sown thickly and cut for hay gives a large yield of forage which is rich in fat-forming but poor in growth-making materials. It gives a larger yield per acre than almost any other crops; but for growing animals, is not so nutritious as Kafir fodder and far inferior to cowpea or alfalfa hay. Its culture might well be confined to the poorer, upland soils, where it serves a useful purpose. Even on these soils, it is yet questionable if Kafir is not the more profitable.

The summary of digestion trials published in Bulletin No. 46 illustrates the main points of difference between sorghum and Kafir.

Sorghum may be used to good advantage to supplement pasture during July and August when the latter is frequently short. If sown reasonably early near to the pasture, it may be cut daily, allowed to partially wilt, and then hauled or thrown into the pasture, or feed lot. A succession of plantings may be made and used in this manner and will in most cases, give a fair yield of hay for the second crop.

## MINOR CROPS.

Among the minor crops grown successfully in some localities are peanuts, broom corn, water melons, canteloupes, and garden vegetables. Success with the last named requires skill and close attention, but the efforts of the specialist are rewarded here as elsewhere.

## PASTURE GRASSES.

The native grasses are the best yet found for pasture in Oklahoma. This statement sums up the experience and observation of all who have given the subject close attention. Up to the present time, nothing has been found that may be sown with reasonable certainty of securing a good stand. English blue grass and orchard grass come nearest to being successful. The trials with Bromus inermis, or smooth brome grass, made at the Station have not been sufficiently extended to determine its value, though it will probably be fairly successful. Most of Oklahoma is a little too far north for the successful growing of Bermuda grass, though it does well in sunny locations and is fair as a lawn grass. Kentucky blue grass requires much nursing and a good stand is exceedingly difficult to procure and maintain.

Native grass pastures may be strengthened by keeping down the weeds and harrowing or disking the thin spots and seeding to some of the grasses mentioned above. The pasture land is a valuable asset of the farm and should not be overstocked. It is better to have two pastures and use them alternately. The native grasses mature seed in succession from May to September and rotation in pasturing is necessary for reseeding. This applies with special force to western Oklahoma where much dependence is placed on native pastures.

## LIVESTOCK.—CATTLE, HOGS, HORSES, MULES, SHEEP, POULTRY.

No single factor will make more for the permanent success of agriculture in Oklahoma than a steady gain in the number and quality of the livestock reared and matured here. There is but one right way and that is gradual improvement by the introduction of pure-bred stock wherever and whenever possible. Even with poor foundation stock, it is possible to build up and improve the quality of the stock in a very few years if none but pure-bred sires are used for breeding purposes. The first cross is a half-blood, the next is three quarters, and the next seven-eighths and practically as good for work, and beef, and pork, and mutton, and fried chicken as pure-bred animals. Farmers should co-operate in this matter and unite to improve their herds by the purchase and use of pure-bred sires and the absolute exclusion of scrub animals for this purpose.

Breeders of hogs are very active and the grade of hogs in the territory is excellent and improving rapidly. More interest is being manifested in the improvement of the grade of cattle, though there is yet much to be done.

Insufficient attention to horse breeding is manifest in the character of many of the horses. The mark of the broncho and Indian pony is much in evidence. The Percheron and Clydesdale and other breeds of horses for farm work and road service should be more frequently seen.

Sheep could be kept on many farms and be made to yield a good profit. The number of sheep in the territory is small and should be increased. Sheep have been kept on the Station farm for a number of years with no losses from disease, and have proven quite profitable.

The poultry industry is well represented in the matter of breeders and poultry associations, but there is a lack of interest among farmers generally in this important feature of farm products. This should not be so, for the climatic and other conditions are such that poultry may be cheaply reared and sold at a good profit. A little thought and care in selection and feeding of chickens and in their marketing is well repaid. The great trouble seems to be that poultry fanciers and farmers do not get together and work for their mutual interests. The local demand for poultry products is good and the supply insufficient at many times.

## SUMMARY OF PRESS BULLETINS.

### KAFIR FODDER.

There is quite a difference in opinion as to the best method of handling Kafir fodder when it is planted thickly, and is to be used for feeding and wintering stock cattle. In general it is believed that the fodder should be cut and placed in small shocks when the grains have passed from the soft stage and become firm. The fodder will yet be green, and if put in large shocks will spoil, but will be excellent feed if properly shocked. In feeding it when prepared in this way the amount given should not be more than the cattle will eat up reasonably clean, if too much is given they will eat only the heads and waste a large portion of the fodder.

### COWPEAS.

The cowpea belongs to the great order of plants called legumes that have the power through the aid of microscopic organisms of using the free nitrogen of the air in their growth. The crop is thus a soil renovator and builder and leaves the land much richer after a crop of cowpeas has been grown upon it, even if the vines are removed as hay. In addition to the above valuable qualification, the grain and vines contain a large proportion of that important ingredient, protein. This is the material that makes growth and is so essential in all food stuffs for young, growing stock and dairy animals to make them do well and yield their owner profit. Hence the crop has two very valuable points in its favor. Much has been said in the past of the great adaptability of the crop for Oklahoma, but still it is grown to a limited extent only. In small areas, at least, it should have a place in the regular crops on every farm. The crop can be utilized to greatest advantage by pasturing off with cattle, sheep, or hogs. In this way almost all of the valuable fertilizing ingredients are returned at once to the land.

The difficulty of properly curing the hay bars the use of the crop for this purpose to any great extent when it can be used otherwise. It is however, advisable to put up a small stack of hay to use in special cases, and it will be found of much value. As an example, at the Oklahoma Experiment Station, shoats weighing about 115 lbs. at the beginning of the experiment were divided into two lots. The first was fed what cowpea hay the pigs would eat in addition to a mixture of one-half Kafir and one-half corn meal. They consumed four and three-quarter pounds of grain for each pound of gain while another lot fed the same kind of grain but no cowpea hay consumed eight and one-fifth pounds of grain for each pound of gain. The lot receiving cowpea hay had a better appetite, ate more grain, and made better gains than the lot that did not receive cowpea hay.

This is only one of the many examples that might be cited to show the value of cowpea hay when fed properly. Used in ways similar to this it is found to be an exceedingly valuable material.

While a very valuable crop to plow under for green manuring, in the majority of cases it will pay best to first pasture it off with stock.

The crop may be planted at any time from after corn planting until after wheat harvest and in some cases later. It should be used more as a catch crop than it is, for instance after wheat and oats. At the Oklahoma Experiment Station, the wheat stubble is opened up with a lister and the cowpeas drilled in the furrow. They are given little or much cultivation as time affords and a fair growth of vines is obtained. The land was enriched and cultivated and not left to grow up to weeds and seed the land. With little preparation, it was ready for another crop.

Cowpeas do well either in drills or broadcast. In drills about two and one-half feet apart, two to three pecks of seed per acre will be required. Of the many varieties, the whippoorwill, or speckled, is the most suitable for general use in Oklahoma. For special cases, other varieties may give somewhat better results. It takes time to build up a soil by growing crops on it, but it may be done in this way and is certainly the most economical method. At first large yields, even of cowpeas, should not be expected on very poor soil.

## WEIGHT OF KAFIR CORN.

A bushel of Kafir corn, fairly well cleaned, weighs fifty-six lbs., and this is the legal weight adopted in Kansas; but this point has not been passed upon in Oklahoma. The above is pretty generally known, but what weight of heads is necessary to make a bushel of grain, and how to ascertain the amount of grain in the heads by measurements are questions very frequently asked. The last two questions are not so easily answered and considerable judgment must be exercised in each case in determining the proper answers. Are the heads with stems from eight to twelve inches long, containing more or less leaves, or are they cut close and free of trash? Are the heads, to be measured, lying loose in a box, or have they been tramped in or settled by a long haul? Referring to data obtained in thrashing out several hundred bushels of Kafir corn from weighed heads, and extending through several seasons, the percentage of grain in a hundred lbs. of heads varies from 65 to 80 per cent. This would mean from seventy-five to eighty lbs. of heads are required to produce a bushel of grain. The average runs about 70 per cent., or about eighty lbs. of heads to produce a bushel of grain. The maximum amount was obtained in a case where the heads were large and well developed, cut close and well cured. The minimum amount of grain was obtained where the heads were rather small with long stems, and not well cured, having some leaves among them. The past fall the Station as received some 300 bushels of Kafir corn in the heads, and the heads were weighed before and the grain after thrashing. Eighty lbs. of the heads were required to produce fifty-six pounds of grain, with very little variation.

Roughly, every two inches in a common wagon box, "120 inches by 36 inches by 41 inches deep," contained one bushel of grain. This determination was made with but one man's Kafir, consisting of seven loads. In this case it was tramped in the wagon as loaded, and then hauled several miles.

## NEW PLANTS.

The enthusiasm of seedsmen frequently leads them to make statements in their catalogues that are not borne out by actual practice under all conditions. A given forage crop may produce abundantly under favorable conditions in a climate very different from that of Oklahoma. A forage crop that does well here may yield very poorly elsewhere. For this reason, farmers everywhere should be cautious before buying largly of untried seeds and plants. There is an Experiment Station in each state that is on the watch for new and good things and these Stations are in a position to know the truth about such things. The Oklahoma Experiment Station is located at Stillwater and inquires of any sort concerning farm topics are always cheerfully answered.

## WEEVIL IN WHEAT.

Considerable complaint is received at the Experiment Station that the weevil is injuring stored grain, particularly wheat. This can be stopped by the use of a liquid known as carbon bisulphide. As purchased at the drug stores, the liquid costs about twenty-five cents per pound but can be purchased in quantity at about ten cents plus transportation. The liquid evaporates readily at ordinary temperatures and the vapor being heavier than air, sinks and is death to all animal life that breathes it although a small amount taken into the lungs does no injury. The gas is also highly inflammable and therefore not even a lighted tobacco pipe or cigar should be brought into contact with it for fear that an explosion may result.

To use the gas the grain to be treated should be in reasonably tight bins. The gas will not penetrate more than about three feet in depth if used in wheat and it should therefore be introduced into the central part of the bin by fastening a wire screen over the end of a pipe of sufficient length and forcing the pipe down and pouring the liquid into the pipe when it may be withdrawn and forced into another place. If the weevil is working on or near the top, the liquid may be poured onto the grain and the bin covered with blankets or canvas for about 24 hours when the gas will have nearly or quite all disappeared. The gas does not injure the grain for growing or milling purposes.

## COOKING FEED FOR STOCK.

There is danger of some farmers being misled by the extravagant claims that are put forth by manufacturers of different apparatus for cooking feed for stock. Many alluring statements are made and plausible arguments deduced to convince the possible purchaser that a great saving in feed and larger gains may be secured by cooking feed for hogs and cattle. If cooking feed is an economical practice, the farmers ought to know it, and if the reverse is equally true, they should know that.

The Oklahoma Experiment Station has not conducted any experiments in cooking feed for stock. This has not been necessary as records of experiments made elsewhere are available and the results are as true for Oklahoma as for anywhere else. These experiments have been summed up by Prof. Henry of Wisconsin in his book on "Feeds and Feeding," from which what follows is taken. Numerous experiments in feeding cooked and uncooked feed to pigs were made in Kansas, Iowa, Ottawa, Ohio, and Wisconsin. Prof. Henry summarizes these trials as follows:

"Including all the trials, then, so far as known that have been favorable to cooking feed, and omitting many, for lack of space, that are unfavorable to the operation, the average shows that 476 pounds of uncooked meal or grain were required for 100 pounds of gain with pigs, while after it was cooked 505 pounds were required. This shows a loss of six per cent of the feeding value of these substances through cooking." In Maine, "The results have in every case pointed to the superior value of uncooked meal for the production of pork."

Looking at the whole matter of cooking feed in the most favorable light, the best that can be said is that "The advantages are very slight and not worth the trouble of either building the fire, cutting the wood or erecting the apparatus, to say nothing of all these cominbed, with danger and insurance added."

## CULTIVATION.

While there are many questions in connection with the relation of soils to moisture that are not well understood, it seems quite well established that the chief thing that is necessary for the growth of good crops is to keep the soil cultivated. Primarily the object of cultivation is to keep the moisture from being lost, either by evaporation or through the growth of useless palnts. Weeds use a large amount of water that ought to go to the crop that is being grown and it is fortunate that in killing the weeds, the surface of the soil is put in good condition for retaining moisture already present in the soil and absorbing that which falls in the form of rain.

There is no new method and none will be found by which crops may be grown without work and by which moisture may be produced in some mysterious way. It is a fact, however, that there is less evaporation from the surface when the soil is loose on top than when it is hard and compact all the way down. The reason for this is that the loose soil acts as a mulch through which the moisture from below will not pass and evaporate. The practical method that is open to Oklahoma farmers is to keep the surface of the soil loose, cultivating as soon as possible after the soil has been compacted by heavy rains. This plan will keep the water in the soil for the use of the crop that is growing. The implement which will do the work most economically is the best, and must be determined by what is available for the purpose.

Crops are grown for the money that may be made out of them. A special method that costs more than the crop is worth is worse than useless, but neglect of a crop when once planted is equally unadvisable. There is a happy medium which each farmer must determine for himself, even though the method that is pursued seems to be at variance with the best practice.

## POISON THE POCKET GOPHER.

The pocket gopher, which does so much damage to meadows and alfalfa fields by throwing up numerous mounds of earths, is causing trouble in some parts of Oklahoma. This pest is easily and cheaply eradicated by poisoning. Generally where there are three or four dozen mounds, one to four gophers are doing all the work. When they are not checked in any way, a whole field of alfalfa is sometimes destroyed.

Rought-on-rats or strychnine are good poisons and either sweet or Irish potatoes may be used to induce the gophers to eat the poison. The potatoes should be cut into quarters, a slit made in each into which poison is introduced by dipping a knife blade into the poison, sticking it into the slit made in the piece of potato, and then closing up. The potatoes are then taken to the field and the underground runs of the gopher found by punching a rod into the ground in a line between two freshly made mounds. When the run is found, which is indicated by the rod going down easily, make an opening into it with a spade, but a piece of the poisoned potato into each end of the run, and close the opening. The mounds should be leveled so that new ones may be easily seen.

This operation should be repeated for every group of mounds and doing it once, if the work is well done, is usually sufficient. Fall or early spring is the best time for the work.

Gophers may be trapped by making an opening into the run large enough so that a steel trap can be set in the run level with the bottom. The trap should be covered lightly with dirt and the opening closed with a board which is covered with dirt so as to exclude all light. Persistent effort using either of these methods will result in the killing of the gophers and the prevention of losses in alfalfa fields.

### INSECTS AND REMEDIES.

Injurious insects seem to be present in unusual numbers this season. The Experiment Station at Stillwater will help what it can toward their control, but every one interested should make it a point to study out means of combat for themselves, often using very vigorous measures because it is frequently a week before a reply from a letter addressed to the Station can be received, and during that time the insect may do several dollars worth of damage.

### CUT WORMS.

The cut worms are very abundant this season, eating all kinds of garden crops and alfalfa and even climbing trees and destroying fruit and foliage. The remedy to be applied must depend largely on the nature of the food plant. In gardens poisoned bait consisting of sweetened, poisoned bran may prove effective. For trees, they should be jarred to the ground and something tied around the stem of the tree over which the worms can not climb. On alfalfa, spraying so as to poison the food or to kill by contact by the use of kerosene emulsion may prove effective, depending upon conditions. In all cases if poultry can be coaxed to eat the worms it is the best way of getting rid of them.

### CHINCH BUG INFECTION.

The Experiment Station is distributing chinch bug infection to all who request it. In several cases it has been found already established in fields either from previous distribution from the Station or naturally. Where bugs are plentiful it will pay every farmer to investigate a little and see if the infection is not already in his crop before requesting more. It will be found under loose earth or dead leaves or between the leaf sheath and the stem of the plant. It will be recognized as nearly white, moldy growth on dead bugs, sometimes nearly covering the bug. It can be easily distinguished from the silvery spots on the wings. If this is found in comparatively small quantities the bugs in the field are in the presence of infection as well as they can be.

### GRAIN LOUSE.

Many inquiries are received at the Station in regard to a small green insect found in the heads of wheat. They are not found in some wheat but in other places they are very numerous nearly covering the heads of wheat. The pest is not so serious as it might at first seem. Either in the egg or mature stage the louse passes the winter and in spring begins to multiply very rapidly by certain individuals bringing forth young alive. In a week to ten days this new generation begins to reproduce so that in a comparatively short time thousands may be the descendants from a common single parent. Their attack on the wheat is so late that probably but little damage will be done anywhere. The wheat would certainly be better off without them for they suck out the juice that properly belongs to the plant and should go to mature the grain. In some fields there are none and in others it is possible, judging from the reports that have come in, that the yield may be reduced 1 to 3 per cent. There are remedies that might be used on a small scale but nothing that is practical on large fields of wheat at this season.

### BROWN LOUSE.

Many plum and locust trees are infested with a brown louse. They work chiefly on the underside of the leaves and on twigs. The lice should be carefully sprayed with kerosene emulsion made as follows: Dissolve 1 1-2 pounds soap in a gallon of hot rain water and when cool add two gallons of coal oil and agitate vigorously until a creamy mass is formed; use one part of the emulsion to nine parts of water for all sucking insects. Apply in a fine, even spray so as to wet the insects thoroughly. A second application may be necessary.

## THE PEACH LEAF CURL.

This disease is much more abundant this season than usual in the territory. The symptoms are a curling and yellowing of the leaves, due to the presence of a fungus on them which destroys the green color and causes the leaves to grow into abnormal shapes. The fungus may often be seen as a light mildew. A part of this fungus makes its way into the young buds which are already forming for the next year's growth. In this place the fungus passes the remainder of the year and is ready to start into growth as the leaves develop the following spring. No opportunity for experiments on this disease has occurred at this Station, but extensive work has been done by W. M. Scott in Georgia on the same disease with the result that Bordeaux mixture made as follows, has proven successful:

1. Dissolve six pounds of blue stone in six gallons of water in an earthen vessel.

2. Slack four pounds of fresh lime in six gallons of water.

Pour 2 slowly into 1 and add twenty gallons of water. Mix thoroughly and strain through coarse gunny-sacking into a barrel. Reject the undissolved material and add eighteen gallons of water and the mixture is ready for use. The mixture will keep in this condition as long as desired.

This should be applied to the trees with spray pump just before they come into bloom. One application is usually sufficient if made at the right time. In orchards that have not thus been treated the disease may be slightly checked by spraying with the same mixture, but leaves that have once been curled can never be restored to usefulness. Then the best thing to do is to keep the trees cultivated and in a vigorous condition so that they will throw out a second set of leaves with which to mature the fruit of the season.

# WINES AND WINE MAKING.

*A. G. Ford.*

Science has given to the wine making industry the possibility of many definite results. To follow out the operation scientifically and according to the most recent methods would call for the expenditure of some money and considerable time. It would be wasting both time and money to attempt to follow out one of these systematized methods unless the wine maker was properly located and then desired to follow the industry on an extensive commercial scale. All the Oklahoma farmer desires are such suggestions in addition to the practical knowledge already possessed, as will enable him to prepare his fixtures and follow out a method, using only what material he may have at his disposal.

However careful the practical farmer or the experienced wine maker may be, they will both have in their cellars spoiled wines to be disposed of. By a study of the most recent methods and a careful observation of the facts brought to light by science, a sufficient amount may be gleaned from them to be of considerable value to the farmer.

## FERMENTATION, THE YEAST.

The air, at the proper temperature and humidity, is filled with myriads of little plants called yeasts. It would require five hundred billions of these little vegetables cells to occupy the space of one cubic inch. These little plants that may be called fungi, pass into an active state and multiply when in contact with a saccharine solution. The bread yeast; which is similar to the wine yeast, requires, however, a starchy substance for its development. The beer yeast develops in the same way as the wine yeast but does not produce as much alcohol. There are also numerous kinds of wine yeast all producing varying quantities of alcohol from the same kind of grape juice, and some producing or causing to be produced very different flavors or aromas.

The yeasts that float about in the air seem to exist in a kind of dormant condition, and do not immediately attack the sugar solution on coming in contact with it. If then an active yeast be used to start the ferment, it will possess very many advantages over the one that lives in the air.

Besides the three yeasts mentioned above, there are many other kinds that live in the air; and unfortunately many of them vastly outnumber the true wine yeast. Many of them develop and grow in the grape juice right along with the wine yeast, setting up conditions that later spoil the wine. Their growth may be very much retarded or practically prevented by keeping the temperature of the solution at a point which is most beneficial to the wine yeast and yet detrimental to its enemies.

The juice which is expressed from the grape contains, on an average about twenty per cent of grape sugar. This grape sugar constitutes the saccharine matter upon which the wine yeasts become active and greatly increase in number. In the process of this germination, the grape sugar in the grape juice is converted into alcohol. Authorities differ as to how this conversion is brought about, some saying that the yeast in its process of growth breaks up the sugar compound into several parts, one part forming into alcohol, another being wasted, while another goes as a food constitutent to the fungus. Other authorities believe that the yeast does not perform such a function, but that it is brought about through chemical changes, initiated by some substances produced by the growth of the fungus.

## PERIODS OF FERMENTATION.

The fermentation that takes place in wine production is generally divided into three periods, the first occupying from three to eight days; the second lasting to the following spring, and the third from the close of the second on for any number of years until the wine is said to be "bottle ripe."

The first period is characterized by a rise in temperature, frothing, and, at the close, a partial settling and clearing up of the wine. In this period, the sugar is changed into alcohol.

The second period may be characterized by a further clearing up of the wine, the development of some aroma, and the assumption of a distinctly wine taste and odor. Some indications as to the success of the operation can generally be detected in this period.

In the third period, the characters that were taken on by the wine in the preceding periods are matured.

## PRODUCTS OF FERMENTATION.

If all of the sugar in the grapes were converted into alcohol, the weight of the alcohol in the wine would be about one-half the weight of the original sugar. Besides this alcohol, there is produced a gas—oxide of carbon, acetic acid, glycerine, aldehydes, and numerous ethers that give the wine its aroma.

Other products that arise during fermentation and the development of the wine are "lees" and argol. The former collects on the bottom of the vessel, and consists of about forty per cent organic matter, coming from the dead yeast cells. The balance consists of mineral salts. The argol collects on the sides of the vessel and is pink in color. This is crude cream of tartar, and from fifty to sixty per cent of tartaric acid may be extracted from the deposit. As the grape juice or "must" ferments, the per cent of alcohol increases; and the argol being not so soluble in this solution, as in the must, begins to separate, and collects on the sides of the vessel.

The increasing per cent of alcohol soon renders the solution unfit for the life of the yeast, and when the alcohol has increased to fifteen per cent, the yeast cells are all dead and fermentation stops. The fermentation may stop long before the per cent of alcohol reaches this figure, depending on the kind of yeast that has done the fermenting, its vigor, and the temperature of the fermenting solution.

### THE PROCESS OF WINE MAKING, PREPARATION AND CONDITIONS.

Deep vessels are preferred to shallow ones, for the reason that the rapidity of fermentation can be controlled more easily. All vessels should be thoroughly cleaned, dried, and cooled before receiving the must. If a cellar be used for fermenting, it should be dry and perfectly free from any kind of mould or suspicious odors.

The grapes should be allowed to fully mature before picking. Green grapes contain very much acid, and very much acid is detrimental to the health of the yeast—they require a neutral solution to accomplish their best results. The picking should be done in very early morning in order to have the grapes as cool as possible when the crushing and fermenting begins. Only ripe and healthy grapes should be used, especially avoiding any soured fruit as this would introduce the acetic ferment, which in all probability would prove fatal to the wine.

If possible, a small vat of must should be started to fermenting a day or two before the large pickings are brought on, and when this small vat is at its highest point of fermenting, some of the yeast foam from it should be taken to start the new vats. This gives a fairly pure wine yeast, and one that is in its active state, and one that will begin work on the new vats immediately.

### TEMPERATURE.

Authorities say that ninety per cent of the failures to produce good wine are due to an improper temperature during the first period of fermentation. The most favorable temperature lies between 75 and 80 degrees Fahrenheit; and never should the temperature vary more than ten degrees above or below this. It would be much better if the variation were but five degrees above or below.

The heat generated by the action of the ferment will raise the temperature of the solution thirty degrees, if no cooling device is employed. Starting with a temperature of 75 degrees, would ensure a temperature of 105 degrees, sometime during the process, if the vats were placed in a hot room to remain throughout the fermentation period. When the temperature passed to 95 degrees or 100 degrees, the action of the wine yeast would diminish, while that of its enemies would increase. Here, perhaps the true wine yeast would die or else refuse to go on with the process of changing sugar into alcohol, while at the same time, some other yeast would be excreting a product that was destined to destroy the wine. If the temperature should fall below 65 degrees, the wine yeast would again become dormant and refuse to do its task, while at the same time, another yeast would take up the work, but would produce a far less amount of alcohol from the same quantity of sugar. Of the two evils—high or low temperatures—the high seems to be the most formidable, yet it is the most difficult to prevent.

If a cellar is convenient, it should be used, as the temperature in summer is not so high as the interior of a house. If there be no cellar or if the temperature goes too high with the use of it, the proper temperature may be maintained by setting the fermenting vessel into a large vessel of cool water. The practice of keeping wet woolen blankets around the vessel and placing it where the wind may have free access to it is often followed. Numerous other schemes as well as machines have been invented to cool fermenting wines, but as they all entail some cost and labor, they will not be discussed here. If some device is not employed to reduce the temperature, when fermentation is carried on in hot weather, the resulting wine will generally spoil sooner or later or else will be of a poor quality.

### TREATMENT OF WINES.

Both water and sugar are very often added to the musts before fermentation begins. Water should never be added if the best wine attainable is desired. If a sweet wine is desired, a little sugar may be added. If the grapes are sweet, use very little, if they be sour, more may be used. It would seem best, however, to use only sweet grapes for sweet wines, and then add to the juice a small quantity of sugar.

If the average grape contains about 20 per cent of grape sugar and if all this is converted into alcohol, the wine would contain about

10 per cent of alcohol. This is about the average per cent for a wine. When much sugar is added, the per cent of alcohol averages about 12 per cent, or perhaps a little less; and this is about as much alcohol as the wine yeast in Oklahoma will ferment.

Cane sugar, when fermented, will give .54 per cent of alcohol. Now, in order to raise the per cent of alcohol in a wine from 10 to 12 per cent—its maximum, there would have to be added one-third of a pound of cane sugar to the gallon. Should sweetness now be desired, add sugar to suit the taste, remembering that the wine is already sweetened by about one or two per cent of glycerine.

The above calculations are only approximately correct and are founded on the assumption that all the sugar would be fermented. It will serve, however, as a guide when sugar additions are practiced.

Alcohol is very often added to wines, and the process is called fortifying. Besides increasing the intoxicating power, it renders the wine a much better keeper. Examples of such wines are Port, Sherry and Maderia, containing, at times, as much as 20 per cent alcohol. This addition should be made just at the close of the first period of fermenting; adding it sooner would kill the yeast or adding it later might give the wine an alcoholic taste and odor.

Tannic acid is sometimes added. This gives the wine better keeping qualities, and, in fact, will cure some of the diseases of wine. It accomplishes its work by precipitating out of the wine some nitrogenous matter that furnishes food for the disease germs. This effect can, in a measure, be produced in red wines by allowing the fermentation to take place in the presence of the hulls. The hulls contain considerable tannin and the water and alcohol will extract it. Care should be taken to always keep the hulls below the surface of the fermenting liquid, as they will quickly sour in the air and thereby produce the acetic ferment.

"Pasteurizing" is a process of treating wines by which their keeping qualities are almost assured. It consists in heating the wine to 140 degrees Fahrenheit and then stoppering the cask so that no air can get in. This temperature kills all the germs usually contained in a wine, and by letting no new germs in, the wine is safe. This process is said not to injure the wine.

## CARE OF WINE.

When the first fermenting period is over, the wine should be carefully racked off into bottles, jugs, kegs or barrels, and for a time, loosely stoppered. Care should be taken to leave all sediment of dead yeast and other matter behind. The wine should now be stored away in a cool, dry place,—preferably a cellar. If, upon shaking up the vessels later, there should be much cloudiness, they should be racked again. Repeat this operation as often as is found necessary. The wine should, by all means, be racked off into new casks by the following spring. The casks should be watched after at all times in order that no stoppers are pushed out and the cask remain open. If any wine should spoil, it should be removed from the good wines, thus preventing the cellar from becoming inoculated with disease germs.

## ANALYSES OF WINES.

The following analyses made by the writer while a senior student of the College in 1898, will give some idea of the composition of Oklahoma wines.

| No. | NAME OF SAMPLE | SPECIFIC GRAVITY | ALCOHOL BY VOLUME | ALCOHOL BY WEIGHT | SOLIDS |
|---|---|---|---|---|---|
| 1 | Concord | .9928 | 8.52 | 6.85 | 1.25 |
| 2 | Herman Jaeger | 1.0297 | 10.20 | 8.20 | 11.57 |
| 3 | Devereaux | 1.0263 | 12.10 | 9.75 | 11.79 |
| 4 | Mixture of Grapes | .9890 | 14.60 | 11.80 | 2.35 |
| 5 | Mixture of Grapes | .9855 | 13.57 | 10.97 | 6.22 |
| 6 | Concord | .9939 | 8.95 | 7.19 | 1.73 |
| 7 | Norton's Virginia | .9975 | 11.60 | 9.28 | 3.27 |
| 8 | Herbemont | .9949 | 8.87 | 7.01 | 1.71 |
| 9 | Catawba | .9925 | 10.35 | 8.33 | 1.78 |
| 10 | Concord | 1.0204 | 13.90 | 11.23 | 10.09 |
| 11 | Concord | 1.0332 | 13.65 | 11.02 | 14.43 |

The first five came from the Experiment Station wine cellar. The next three came from a local wine-maker, one mile west of Stillwater. The next one—number nine—came from Oklahoma City; and the last two came from ten miles south of Stillwater.

It will be seen that these wines are quite variable in percentage of alcohol; and the solids are extremely variable—ranging from a per cent that is entirely too low to that which is absurdly high. The last two wines had considerable sugar added to them. It will be noticed in both that their specific gravities are high as well as their alcoholic and solid contents.

The grapes from which these two wines were made came from different localities, but were fermented in the same season, by the same person, and by the same process. These wines were fermented without exposure to the air.

The following analyses were made by the writer in January 1899 and in January 1900. They are wines taken from the same corresponding casks, one year having intervened between the sampling. The wines were all dark red in color.

| Station Number | 1899<br>Name of Sample | No. | Specific Gravity | Alcohol by Volume | Alcohol by Weight | Total Acids as Tartaric | Solids |
|---|---|---|---|---|---|---|---|
| 1409 | Norton's Seedling .......... | 1 | 1.0018 | 10.33 | 8.25 | .58 | 3.29 |
| 1410 | Norton's Seedling .......... | 2 | .9959 | 15.43 | 12.53 | .72 | 3.92 |
| 1411 | Norton's Seedling .......... | 3 | 1.0078 | 17.30 | 13.92 | .71 | 7.35 |
| 1412 | Norton's Seedling .......... | 4 | 1.0513 | 14.65 | 11.26 | .67 | 17.90 |
| 1413 | Norton's Seedling .......... | 5 | .9945 | 16.30 | 13.27 | .64 | 3.98 |
| 1415 | Norton's Seedling .......... | 7 | 1.0707 | 13.80 | 10.41 | .54 | 22.70 |

Same wines as analyzed one year later:

| Station Number | 1900<br>Name of Sample | No. | Specific Gravity | Alcohol by Volume | Alcohol by Weight | Total Acids as Tartaric | Solids |
|---|---|---|---|---|---|---|---|
| 2050 | Norton's Seedling .......... | 1 | .9998 | 9.90 | 7.44 | .89 | 3.27 |
| 2051 | Norton's Seedling .......... | 2 | .9961 | 14.00 | 11.26 | .92 | 3.95 |
| 2052 | Norton's Seedling .......... | 3 | 1.0075 | 16.00 | 12.74 | .89 | 7.41 |
| 2053 | Norton's Seedling .......... | 4 | 1.0510 | 13.70 | 10.44 | .86 | 18.02 |
| 2054 | Norton's Seedling .......... | 5 | .9948 | 16.10 | 12.98 | .81 | 4.05 |
| 2055 | Norton's Seedling .......... | 6 | 1.0248 | 16.40 | 12.84 | .78 | 11.76 |
| 2056 | Norton's Seedling .......... | 7 | 1.0710 | 14.20 | 10.62 | .63 | 23.29 |

The analyses of 1899 show the wines to contain considerable alcohol and as a whole are fairly uniform in amount. The acids are a little low, while the solids are all too high.

The analyses of 1900 show a slight decrease in per cent of alcohol, except number seven, which has slightly increased. All the acids have increased, bringing the amount up to full strength. All solids have increased excepting number one which stands at about the same per cent during the entire year.

The cause for the decrease is alcohol is probably due to part of it passing into ethers and some going into acetic acid, which has raised the acid per cent. This increase in solids is perhaps due to cane sugar passing into glucose, the resulting product being heavier than the cane sugar alone; also to the development of small amounts of glycerine during this and other changes.

Sample one had no sugar added to it at any time, and as a result it is lowest in alcohol and solids. Numbers two, three and four had one, two, and three pounds per gallon respectively added to the mashed grapes. Numbers five, six and seven had one, two and three pounds respectively added to the must. Theoretically, there should be no difference —getting the sugar in before fermentation is quite sufficient.

All of these wines were racked on September 30th, October 10th, and November 30th, 1898, but since then no further treatment has been given them.

## SUMMARY.

Everything about the winery should be kept perfectly clean.

Only sound, ripe grapes should be used.

The temperature during fermentation should be kept between 75 degrees and 85 degrees Fahrenheit.

The wines should be racked until no further sediment is deposited.

## GRAPE GROWING.

*O. M. Morris.*

Grape culture is fast becoming an important industry in Oklahoma. The vines make a good growth and bear well in most parts of the territory. According to the reports received at the Experiment Station, grape vines have proven to be the most uniformly hardy and productive of any of the fruit-bearing plants. There are many varieties that are well adapted to the soil and climate and have been grown here long enough to prove their worth.

Many new and promising varieties are being introduced and successfully grown in different parts of the territory, and it is to be hoped that this work will be continued until each locality has its own list of varieties. The reports published in Bulletin No. 43 of this Station placed Moore's Early, Concord and Worden as the best three black grapes; Delaware and Catawaba as the best red grapes, and Niagara, Moore's Diamond and Goethe as the best white or pink grapes. These are named in order of ripening under each color. There are many other grapes that are doing as well as these where planted, but are not so well distributed over the territory. The Concord is the most common grape in Oklahoma and in most localities is giving fair satisfaction. In many vineyards, however, it does not ripen its fruit evenly and is beginning to fall into disfavor on that account. The Herbemont, Jaeger, Cottage and Brilliant are gaining favor and promise to become popular and profitable varieties. Other varieties of special promise are Rommel, Admirable, Early Ohio, Fern Munson and Green Mountain.

### PROPAGATION.

The vines can readily be grown from seed, but as they do not come true from seed, this method of propagation is seldom employed and only when it is proposed to rear new varieties. The vines are usually grown from cuttings. These are made in the late fall or winter from the mature wood of the last season's growth. The cuttings are made from 6 to 12 inches long. Some prefer a three joint cutting, but this is too long to be handled economically in long jointed vines. The cut at the base of each cutting should be made just below the node. The cuttings should be made as soon as the wood is cut from the vine and placed in moist earth or saw-dust, out of the reach of frost, but in a cool place, until spring. The best practice is to bury the cuttings in well drained soil, covering them with about 6 inches of loose soil. They should be kept in their winter storage until the trees and vines have started well into growth. They are then taken up and placed in the nursery row. If the cuttings contain three buds, they are placed so that the top bud will be just above the ground; if the cuttings have but two buds they are placed with the top bud at or a little below the surface of the soil. The soil is well firmed around the cutting to keep it moist and to give the roots the best opportunity to grow. The cuttings are set from 10 to 18 inches apart in the row. The rows are about 4 feet apart. The soil should be rich and in a high state of cultivation. The age of the plants dates from the time the cuttings are set. They are commonly cultivated in the nursery until they are two years old when they are ready to be transplanted to the vineyard.

Good strong plants can be started from layers of the ripe wood. To start plants in this way the strongest canes should be selected and bent to the ground in the spring and covered with soil. The vines will send up a new plant at every bud and if strong plants are desired it is best to remove all but one bud on each layer. The plants should be separated from the parent vine in the fall and transplanted either to the nursery or to the vineyard.

Some varieties do not start well from cuttings. These may be grafted on cuttings or roots of other varieties and grown with entire success. It is usually best to leave the work of grafting to the nurserymen, but the following directions are given for the benefit of those who wish to make a trial at the work.

The whip or tongue graft is most commonly used in grafting cuttings or young vines. The stock should have two buds and the cion one or two buds depending on the length of the joints. The top end of the cuttings to be used as a stock is cut with a long sloping cut. The knife is then placed just above the upper edge of the pith and pressed down to split the end of the cutting and form a tongue. This split should not extend down further than the lower edge of the cut, across the end. The lower end of the cion should be cut and split in the same way. The two pieces are then pushed together so the tongues will hold them in place. The grafts are then wrapped with twine or some similar material to hold them together. In placing the cion and stock together the edge of the wood of the two pieces must meet at least on one side. After the grafting is done the grafts are treated the same as cuttings. When set in the nursery row the point of union should be placed below the surface of the soil. The operation of grafting on rooted cuttings or small plants is performed in the same way as just described. If the plants are taken up they should be handled the same as cuttings, only using more care to prevent their drying. If the plants are not taken up to be grafted the soil should be removed below the first joint roots and the cion inserted below this point in the same way as on a cutting. However, if the stock is large, this will be impossible and it will be necessary to split the stock and insert the cion in the side, or make a sloping cut in the side of the stock and insert the cion. The soil must be well packed around the graft to prevent it drying out.

## PREPARATION OF THE LAND.

Vineyard lands should be in good cultivation before the plants are set. Bad weeds can be eradicated more easily while the land is planted to annual crops than after it is set in vineyard and every precaution should be taken to see that it is free from such. Coarse trash and litter should be removed, and not plowed under, so that the soil will be in a uniformly fine condition. It is best if the land be plowed early in the fall before the vines are set. The land should be cropped for several years before being set to a vineyard, in order that a good deep bed may be ready to receive the plants.

Much of the land in Oklahoma does not contain much vegetable matter, hence it bakes and crusts badly and does not retain moisture as well as it should. This defect should be corrected as much as possible before permanent planting is done. The best treatment for such land is to add large quantities of barnyard manure and turn under green crops. This work should be well done in order to give the vines a good start. After the vineyard is started the manuring will be rather a difficult process and usually shallow cultivation will be the only stimulus and aid to the fertility of the land.

## SETTING THE PLANTS.

The plants are set in the fall or spring. The arrangement of the farmer's work is usually the controlling factor in this matter. There seems to be but little difference in results whether the plants are set in the fall or spring, if they are in good condition and well set. If the plants are received in the fall they will usually have better winter quarters if set in the vineyard immediately. The plants should be set the same depth in the vineyard that they were in the nursery row but better be set deeper than shallower. The roots are placed in their natural position and the soil well firmed around them. But little if any pruning will be needed. The roots should not be exposed to the air and become dry. Neglecting to keep the roots damp while transplanting causes nearly as much loss as all other causes combined.

The plants should be set in rows 8 or 9 feet apart in the row. The weak and medium growing varieties like Delaware and Moore's Early may be placed from 6 to 8 feet apart in the row while the stronger growing varieties like Herbemont and Lenoir should be placed from 10 to 14 feet apart in the row. The character of the soil and the method of pruning and trimming will also have some influence over the amount of space that each plant should occupy. If the plant is pruned very close each year, it will require but a small amount of space, but if a large amount of wood is left the space for each plant should be increased proportionally.

It will be of advantage to have the rows run north and south. This will place the trellis so that the trunk and base of the vine will receive the most protection from the sun. This will be of great advantage in spraying as a spray can be thrown across a strong current of air better than it can be thrown against it. The wind will not tear so many vines from the trellis if the rows run parallel to the prevailing winds, and in large vineyards the expense of keeping the vines on the trellis is of considerable importance.

## CULTIVATION.

Clean cultivation should be followed from the first. A crop of early potatoes or something similar may be grown between the rows for the first year, or two, but this is not to be recommended lest the crop and not the vineyard receive the favor in cultivation. A regular system of cultivation should be determined upon when the vineyard is planted and should not be changed from year to year.

The surface soil is usually hard and compact in the spring, and it is a good practice to turn it with a small turning plow, running shallow so that it will not strike any of the large roots of the vines. This plowing gives an opportunity to turn under any trash or manure that may be upon the ground. This early stirring of the soil is beneficial in several ways. It increases the chemical activities in the soil; it increases the water holding capacity of the soil; and if carried on from the time the vineyard is set, will induce a deeper root growth. After the plowing, the land should be smoothed down with some lighter tool, as a harrow or cultivator.

The spring and summer cultivation should be shallow and frequent. No weeds or grass can grow in the vineyard without doing it harm. The vines alone should have all the moisture that the land contains. Cultivation may be stopped about the last of July or the first of August.

Little growth should be made after this and the force of the vines should be spent in maturing the growth already made and the fruit. The soil should be in good condition the entire year. The greater part of the winter-killing of buds and vines is due to the dry and baked condition of the soil. This condition can not always be avoided but a little cultivation would greatly improve it in most cases.

When one system of cultivation has been adopted it should not be changed without some good cause. The principal object of the summer cultivation is to conserve moisture and destroy the weeds. Where shallow cultivation has been practiced entirely for a few seasons and the vines are giving fair returns, the deep plowing should not be attempted, as it will result in a very severe root pruning. But when it is determined to begin deep cultivation after shallow cultivation has been practiced, the start should be made in early spring, and the vines should be pruned very close. If the vines do not receive good care with such treatment it will result in more harm than good.

## PRUNING.

Pruning and training are separate and distinct operations. Pruning is the cutting away or removal of some part of the plant for the purpose of benefitting the plant or its fruit. All the different modes of pruning are intended to bring about the same results and are based on the same principles. The vines can mature only a small portion of the fruit and wood that would be formed from all of the buds of one season's growth. This fact makes pruning a necessity. The fruit is borne on a few clusters near the base of the shoots of the season; these shoots start from buds on wood of the previous year's growth. These are the facts and conditions upon which all intelligent grape pruning rests. Training refers to the arrangement of the vines on the trellis. Some systems of training are better adapted to certain modes of pruning and can not be used with certain others. While there are only two princiual methods of pruning, there are as many different systems of training as there are fancies among grape growers.

In the following discussion the green leafy branches are called shoots. The ripening shoot is called a cane. An arm is a branch two or more years old and bears the canes and shoots, but does not change its form from year to year. An arm is designated as upright, horizontal, or sloping according to its position on the trellis. By some writers, an arm is called a cordon. A spur is a cane cut back from one to four buds. A renewal is a cane left for bearing wood but cut much longer than a spur. A stem or trunk is that portion of the old vine that reaches from the ground to the trellis.

### EARLY PRUNING.

The vines should be cut back to two or three buds when set and to about the same number the following winter. If the vines are strong they may form the cane the second summer, but little more than the cane should be left. If the plants are weak they should be cut back about the same as after the first year's growth, and not be permitted to form the cane until the third summer. The pruning should be so done as to prevent heavy bearing for the first three or four years.

### WHEN TO PRUNE.

The pruning may be done at any time during the winter. The vine ceases to grow when the leaves fall and is dormant until growth starts in the spring. Tender varieties do best when pruned in the fall, and laid down and covered with earth or straw to protect them during the cold weather. The strongest growing and most hardy varieties suffer less from winter drouth if pruned in the fall. The roots are dormant and take up but little moisture and when the winter is excessively dry the vines suffer for water and many of the buds are killed. If the most of the vines were removed in the fall much loss from winter-killing would be avoided. The pruning should not be done while the vines are frozen, as the canes will be broken and split in removing the extra wood. The work should be finished two or three weeks before growth starts in the spring in order to avoid bleeding. The cut should be made two or three inches from the last bud that is intended to grow, so that the cane drying at the end will not injure the bud. Ten or fifteen buds will usually be enough for the vine to support for its first crop. This number can be increased from year to year until the fourth crop, when the vines should be in full bearing and should support from twenty-five to thirty buds of bearing wood.

The most convenient tool for cutting the vines is a pair of small hand shears. These may be purchased from any hardware store for 50 or 75 cents.

### SUMMER PRUNING.

Most of the successful grape growers in Oklahoma are strongly opposed to summer pruning. The results of the work done in the Station vineyard seem to be very strong argument against it. It is a good practice however to clip off the ends of the most advanced shoots just before the plants bloom. This will check the growth of the most forward shoots, and give the tardy ones a start. The strongest shoots will be at the outer end of the cane or arm; and this condition must be overcome as much as possible. Cutting off the ends of the most advanced shoots is the best remedy and gives the shoots near the trunk a greater food supply. This pruning however should not be continued till summer, but just while growth is starting in the spring. Summer pruning prevents the fruit from maturing and if carried on for a number of years, will weaken the vines and in some cases kill them. The cutting back or removal of the shoots that start from the base and side of the trunk may be of positive benefit, but more than this is scarcely advisable.

### MODES OF PRUNING.

The bearing top or head of the vine for the succeeding year is formed either by spurs or renewal. The spurs do not vary much in length but the renewals vary from six or eight buds to nearly the entire vine. With the spur method a large amount of old wood is carried in the spurs and arms. The spurs add only a small amount of wood each year, but this can not be removed without changing the method of pruning or the loss of a crop. Each year adds a spur to the spur of the preceding year, thus moving the bearing wood further from the trunk. The accumulation of large quantities of old wood is injurious to the growth and health of the vine. The old spurs form excellent hiding places for insects and diseases. This system of pruning is not so popular as it was a few years ago and is now rapidly passing into disfavor. The renewal usually starts near the head of the trunk but in some vineyards it is brought from the ground each year. This latter method requires a very low trellis and very strong growing vines. The vines that come from the ground are usually less productive than those that come from an arm or trunk. The position, number, and length of the renewals will depend on the system of training adopted. The strongest unbranched canes should be used where choice is left. The canes that are branched will not bear fruit as uniformly as the unbranched canes. This mode of pruning is very simple and easy to follow and can be readily adapted to any form of trellis or system of training. The amount of old wood is reduced to a minimum. The position of the bearing wood is largely under the control of the pruner. This method of pruning is gaining favor and is practiced by most of the successful vineyardists in the south and west.

### TRELLISING AND THE TRELLIS.

The vines should be placed on the trellis as soon as large enough. If permitted to spread at will over the ground they prevent clean cultivation and encourage the spread of disease and insects, and are in such shape that these pests can not be fought. It is seldom necessary to place them on a permanent trellis the same year they are set. If the vines make a very strong growth they may be placed on a temporary trellis to keep them out of the way of the cultivator. A very good temporary trellis can be made by placing stakes about two feet higher in the row so there will be two or three vines between each two stakes and placing the wire on the top of these stakes.

Good sound posts should be used on the permanent trellis. Cedar, catalpa, black locust, osage orange or bois d' arc and post oak make good posts for trellis. If the posts are set they should be placed not less than two feet in the ground. If they are driven they should stand six or eight inches higher than is necessary for trellis, in order that they may be driven deeper and tightened from time to time. They should be placed so there will not be more than three vines to the post and two vines to the post will be better. Two or three large vines make a heavy load on the wires and a strong wire must be used to support such a load. A number 8 or 9 smooth galvanized wire will best serve the purpose. The iron wire may be used but it will not last as long nor stand the strain as well as the other wire. It is better to run the wire through the post than to trust to staples to hold the wire.

There are two forms of trellis in general use. The most common form is an upright trellis composed of two or three wires placed one above another. The wires are placed from fifteen to twenty inches apart with the lower wire twenty or twenty-four inches from the ground. This trellis is seldom more than five feet high and usually less. It is simple and easy to build and admits of many different forms of training. It is intended that this form of trellis will hold the vines so that the fruit will be exposed to the sun and the air the same as if trained to a wall.

The canopy formed trellis is entirely different from the one just described. This trellis contains three wires all placed about the same distance from the ground. The three wires may be on a level with each other or the center one placed a little below the other two. The Munson trellis is the best example of this form. It consists of three wires so placed that the center wire is five feet and six inches from the ground, and about six inches below the other two, which are two feet apart. This trellis may be made by placing posts for each of the outside wires and attaching the center wire to a cross wire fastened to the posts. A simple form is to have the center wire fastened to the posts and the two outside wires fastened to a cross bar on the same post. This will usually be cheaper and easier to maintain. Mr. Munson in the Farm and Ranch of October 21, 1899, states some of the advantages of the Munson trellis as follows:

"1. It accommodates the nature of the vine by furnishing a leafy well ventilated canopy over fruit, vine and root, and allows the fruit to hang in free air, so no chafing occurs against the wires, or post or vine.

"2. It puts the work of pruning, tying, spraying and harvesting in the most convenient position possible to save backache and do the work most expeditiously, with the least inconvenience, and permits passing from row to row through the vineyard, at any point by slightly stooping.

"3. It allows more readily of cultivation than any other continuous trellis.

"4 It permits free circulation of air and wind storms, thus keeping the ground better aereated in wet weather, helping to restrain disease, and avoiding blowing down of trellis, hence enabling it to last longer. The sheet of leafy vine, being held horizontally and edgewise to the winds, gives little resistance, and furnishes even exposure of the fruit to light, heat and air; hence secures even ripening.

"5. In cold climates, where vines have to be covered in winter, it permits the vines, as soon as pruned, to be readily laid down to be covered, and easily raised to be tied up in spring."

The mode of pruning and training must conform to the trellis and but little choice is left in this matter with the Munson trellis.

## TRAINING.

The fan system of training on the upright three wire trellis is the one most commonly used in small vineyards in the territory. The vine usually has but one trunk leading to the first wire. Hence the trunk branches and the bearing wood is spread upon the trellis in the form of a fan. The shoots run in all directions, some along the wires, some up over the top of the trellis then down and others start down directly from the cane. The top wire is very heavily loaded and the two others bear but little weight. If the vine is a very strong grower the shoots will form a dense canopy from near the ground to the top so the fruit will get but little light and air and will be in the most favorable condition for insects and diseases to work upon it.

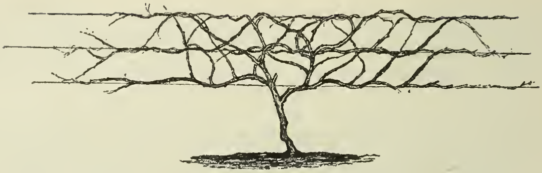


Figure 1.

Figure 1 shows an unpruned vine trained according to the fan system. The previous pruning has been done according to the renewal method. Figure 2 shows the same vine pruned and tied according to the fan system of training as practiced in many vineyards. The canes from *a* to *b* bore the fruiting shoots of last season and the wood between *b* and *c* is to bear the fruiting shoots the coming season. The shoots nearest the tip of the cane have grown the strongest and have been kept for that reason. This system of training greatly encourages the growth of the outer shoots and unless care be taken in pruning the bearing wood will soon be removed a long distance from the trunk. It would have been better to have left a good cane near *a* for the bearing wood. Figure 3 shows a common form of vine, spur pruned and trained according

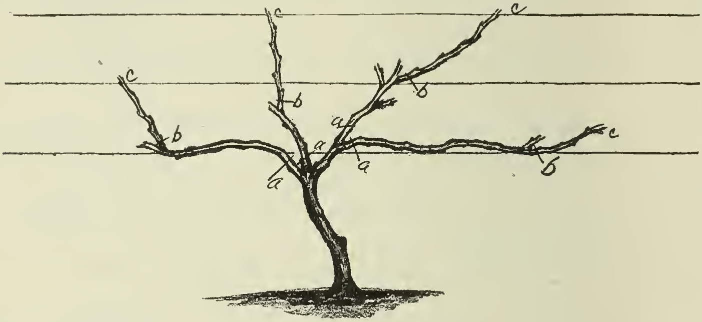


Figure 2.

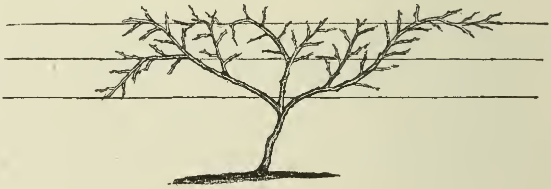


Figure 3.

to the fan system. The open space near the top of the trunk has been caused by leaving too much wood, which has resulted in smothering out the lower vines. This vine would be better if one-half or two-thirds of the wood was removed.

The horizontal arm system of training is quite common and has many good points to recommend it. It allows free circulation of air among the vines and places the vines within easy reach of the spray. It makes pruning a very simple operation and does not confine the practice to any one method. However the expense of keeping the vines on the trellis is greater than with any other well defined system of training. An upright three or four wire trellis is always used. The arms or bearing canes are laid along the lower wire, one in each direction. The shoots are trained to run up and over the top wire and are then let run at will. Figure 4 shows a vine pruned according to the renewal method.

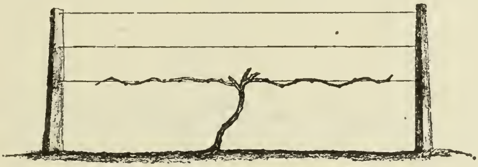


Figure 4.

The Kniffin system of training is not as widely known as its merits deserve. This system is practiced on an upright two or three wire trellis. The lower wire should be about two and one-half feet from the ground and the top wire about three feet from the first one. The bearing wood is supported by a single trunk. The arms or bearing canes are placed in a horizontal position, one extending in each direction along the lower wire and one in each direction on the top wire. The young shoots are not trained to the trellis, but let hang from the cane. The vines require no attention to keep them in position after they are first placed on the trellis in the spring.

Figure 5 shows a vine before pruning. Figure 6 shows a vine pruned.

The Munson trellis will hardly admit of more than the one system of training that is always practiced upon it. The bearing wood is supported by one, or sometimes two trunks that reach from the ground to the trellis. The renewal method of pruning is most always practiced. The strong unbranched canes starting from near the trunk are preferred for bearing wood. The canes are trained along the lower wire of the trellis and the shoots reach out to the wire on either side and wander over the trellis at will. About the only training necessary is to

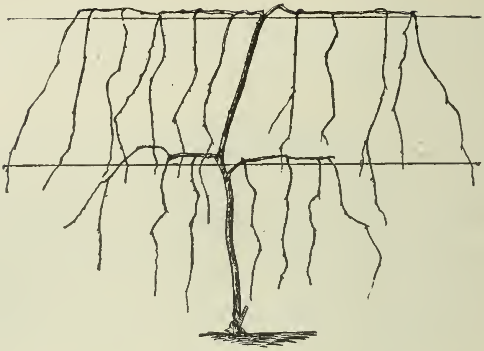


Figure 5.

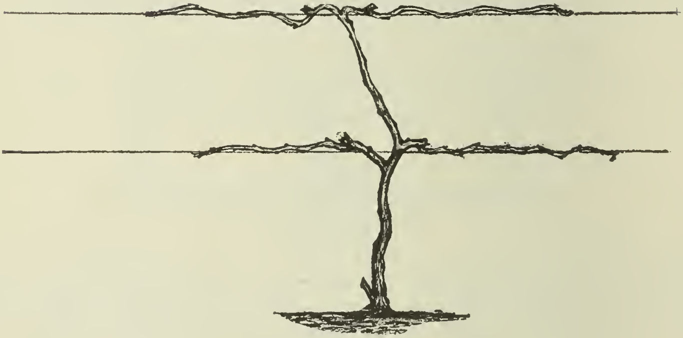


Figure 6

fasten the canes on the trellis in the spring. There will be an occasional shoot that does not start in the right direction to reach the outside wire, but these can be quickly placed on the outside wire and fastened. After the shoots become attached to the wire by the tendrils they can hardly be loosened by the wind.

Figure 7 shows the position of the renewal in early spring. Some prefer to leave four renewals in which case there will be two extending in each direction from the trunk.

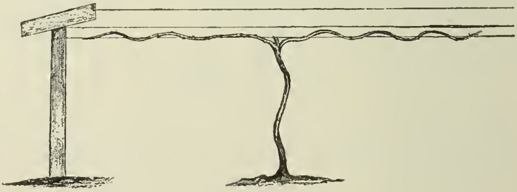


Figure 7.

# FUNGUS DISEASES OF GRAPES.

### ANTHRACNOSE: SCAB: OR BIRD'S EYE ROT.

This disease is scattered over a good portion of the territory but has not caused much damage yet. It is one of the worst of plant diseases, as it attacks the fruit and all green portions of the plant and is very difficult to handle. Most of the methods of treatment prove unsatisfactory. The first appearance of this trouble should be vigorously met and all possible care taken to prevent its spread.

This disease may appear at any time during the growing season. It commonly appears on the shoots soon after growth starts in the spring. Its presence on the shoots is first indicated by the darkening and sinking of the bark in small oval or oblong spots extending lengthwise of the shoots. If the disease is abundant the shoots soon have a speckled appearance. These spots usually enlarge, the greater portion remaining black with a more or less distinct line of purple around the edge. After a time the center turns gray and forms a scab; this is the fruiting portion of the disease. Limbs badly affected are severely checked in growth or killed. The leaves are attacked on the stem and vines show the same marks as on the shoots but on the blade of the leaf the spots turn brown. The stems of the clusters are also attacked, and where the spots girdle a stem the fruit below the girdle does not ripen but remains green and withers.

The disease usually appears on the berries when they are about half-grown. The diseased portion is brown with the characteristic red or purple margin and round in outline. The discolored part is sunken and later turns to a lighter or gray color, which is caused by the fruiting portion of the fungus rupturing the skin and forming a scab. Some varieties are more susceptible to the disease than others. Among those most susceptible to its attacks are Goethe, Agawam, Vergennes and Diamond.

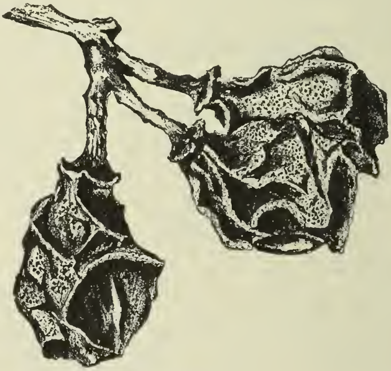
Treatment:—Treatment should begin early, before the buds open in the spring. The following solution is very good to apply as a wash before the growth starts in the spring.

Iron Sulfate (Copperas) 70 lbs.
Sulfuric Acid 1 pint.
Warm water 16 gal.

The acid should be poured over the crystals of iron sulfate and then the water added. This if well applied will kill all of the spores that have lodged on the vines over winter. When this solution is used the vines turn black and any part of the vine that has not turned black within a day or two after the first application should be washed again. Bordeaux mixture is of value in holding the disease in check on the growing vines. The first application should be made soon after the buds have started in the spring and repeated about every two weeks till the fruit is about half grown. If it is necessary to spray after this time, the ammoniacal solution of copper carbonate should be used as it does not stain the fruit and is nearly as effective.

### BLACK ROT: OR CHARBON.

The fruit when affected with this disease turns to a deep black color, hence the name. The fungus causing the disease attacks all parts of the plant. On the stem it causes black, oval, sunken spots which soon show a few dark pimples in the center. These pimples are the fruiting portions of the disease and make this disease easy to distinguish from others. The affected portions of the leaves turn to a dark reddish brown color and are usually near the large veins but are not centered upon them as in the Anthracnose.



Black Rot.

This disease seldom attacks the fruit till it is full grown. If the fruit is green the affected portion turns to a purplish brown, and this color soon spreads over the entire berry. Minute black pimples appear scattered over the surface and finally the berry withers, turns black and ultimately dries up, but, as a rule, remains firmly attached to the stem. These little pimples soon break through the skin and throw off the spores of the disease. It requires from two to three weeks after infection for the disease to complete its growth. The rapidity of growth and spread of the rot depends much on the condition of the weather. A warm moist atmosphere is very favorable to the development of the disease.

Treatment:—Much can be done to prevent the disease by training the vines on a good trellis to admit as much air and light to the fruit as possible. Although the disease does not appear till late in the season the preventive measures should be in operation before there are any signs of the attack. Spraying the vines with Bordeaux mixture or ammoniacal solution of copper carbonate are perhaps the best remedies known. The first application should be made about the time the vines have set three or four leaves. The second application should be made about two or three weeks after the first and the third about two weeks after the second. If the vineyard is badly infected the applications should be repeated about every two weeks till the fruit is ripe.

### BROWN ROT: GRAY ROT: DOWNY MILDEW.

This fungus attacks the leaves, young wood, flowers and fruit. It is first distinguished on the leaves by greenish-yellow spots on the upper surface while the corresponding undersurface is covered with a white frost like growth. As the growth progresses the mildew disappears, leaving the leaf dead and brown. The young wood and flowers present much the same appearance when attacked. This disease seems to develop in two forms on the fruit. One form is called brown rot the other gray rot. The brown rot does not make its appearance till the fruit is nearly grown. As this time small brown spots appear and soon cover the entire berry. The berry becomes very soft and falls from the stem at the slightest touch or jar. The skin remains unbroken till the berry falls. In the gray rot the berries are covered with the same kind of growth that appears on the leaves and stems.

Treatment:—This disease is most abundant on wet land and on vines that are on the ground or a very low trellis. If the vines are on a good trellis and so trained as to give the air a chance to pass freely through or under the vines but little trouble need be had. The Bordeaux mixture is a sure preventive for this disease. The first application should be made when the shoots are six or eight inches long and every two or three weeks thereafter.

### RATTLES OR DROPPING.

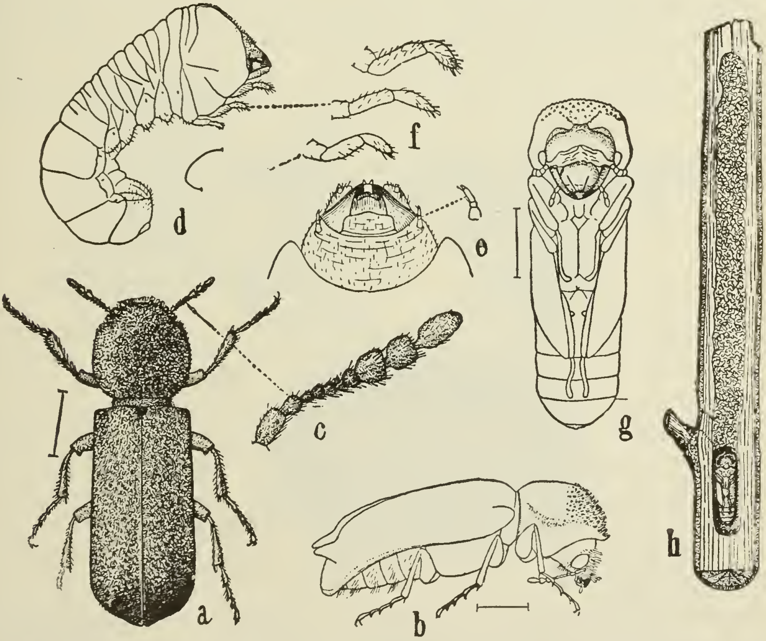
What is known as Rattles, or Dropping of the Grape has caused considerable loss in some vineyards. The trouble is not due to any definite disease or insect but to the combined effect of drouth, disease, and insects in which drouth is the most prominent factor. Preventive measures should be directed towrad improving the health and vigor of the vines. It will usually be beneficial to fertilize the land and improve the method of cultivation.

# INSECTS AFFECTING THE GRAPE.

*E. E. Bogue.*

## STEM BORER.

The damage caused by this insect—unlike that produced by some other borers—is done, not in the larval stage of the insect, but in the perfect stage, by the beetle itself. It works on the apple, pear and cherry.



The apple twig borer, "a," beetle as seen from above; "b" same in outline as seen from the side, showing projections on wing covers; "d," larva; "g," pupa; "c," antenna; "e," head of larva; "h," pupa in burrow; all but "h," much enlarged.

It attacks the twig just above a bud and bores a cylindrical hole for several inches in the center of the twig causing it to wither and die. The early stages of this insect are not well known.

Remedy.—The injured twigs should be cut out and burned. No sure preventative is known.

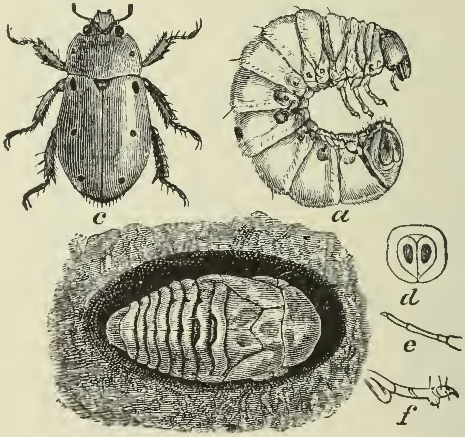
### GRAY SKELETONIZER.

This beetle much resembles the Brown-backed skeletonizer in the character of its work but is less than a quarter of an inch long and one-eighth of an inch broad. It is dark-gray in color and when disturbed it falls to the ground and lies stupid where, on account of its color, it is hard to see.

Remedies.—It succumbs to poisons, but if poultry can be induced to feed upon it there need be but little trouble in getting rid of the beetle.

### SPOTTED VINE-CHAFER.

This is a large beetle about one inch long and half as broad and rather thick. The wing-covers are tan yellow or reddish brown, and each has a black spot at each end and one in the middle of the margin, and there is also a black spot on each side of the thorax. The under side of the body is a deep bronze-green. The legs of some individuals are the color of the wing-covers and of some others the color of the under side of the body. The larva feeds on decaying roots and stumps. It is not usually a troublesome insect, but some complaint has been heard of its eating the foliage of the grape.



The spotted vine chafer, "a," larva; "b," pupa; "c," mature beetle.

Remedy.—On account of its large size, hand picking can be recommended. Spraying with poisons is also effective.

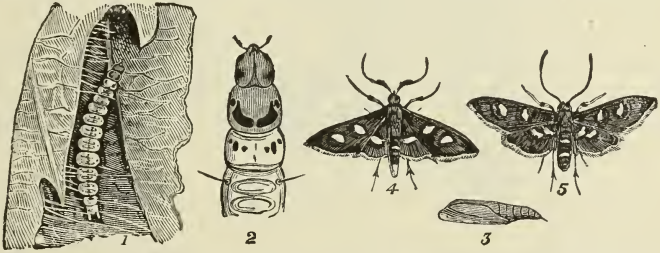
## BROWN-BACKED SKELETONIZER.

This beetle is about five-sixteenth inches long by half as broad, varying in color from reddish brown to black. It works in spots in the vineyard eating out the green pulp of the leaves and leaving only the frame work or skeleton.

Remedies.—It may be destroyed by poisoning the foliage, spraying with Paris Green or London purple but it would probably be more satisfactory to induce poultry to feed on the beetle.

## THE GRAPE-VINE LEAF FOLDER.

The work of this insect is known by its beginning on a small portion of the leaf of the grape, rolling the upper surfaces together and fastening them with silk. It feeds on the inside of the roll and is thus out of the reach of ordinary insecticides. The full grown larva is about three-fourths of an inch long. It changes to the pupa stage within the folded leaf, from which the moth emerges. The moth is about one inch broad when the wings are expanded. The wings are nearly black, with a few white spots and a faint white margin. There are two broods each season. The larva of the first brood appear in May or June in Oklahoma and the last one in August. The last brood passes the winter in the rolled leaves.

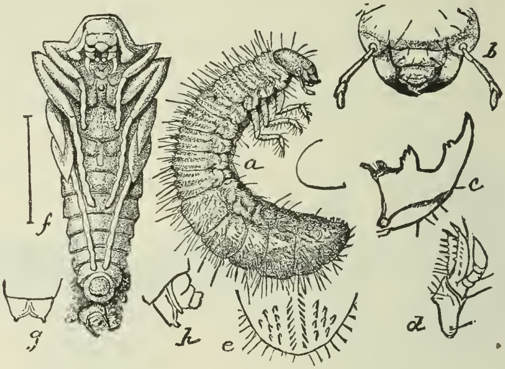


The grape vine leaf folder. "1," larva, natural size; "2," front part of body, enlarged; "3," pupa, natural size; "4" male moth, natural size; "5" female moth, natural size.

Remedies.—The insect has a parasite that doubtless does a good deal toward keeping it in check. This may be preserved and the enemy destroyed by collecting the rolled leaves before the moths escape from them and enclosing them in any kind of a receptacle that may be covered with a piece of loosely woven cloth that will allow the small parasites to escape, but will hold the moths. With a little care and observation this can be done very successfully. However, some recommend that no attention be given the parasite, but burn the leaves as soon as collected, which will destroy both parasites and moths. Spraying with Paris Green as soon as the first insects appear is effective.

### THE ROSE-CHAFER.

Most of the fruit growers of the territory are familiar with this beetle. Its habit of feeding on the flowers of the rose gave to the beetle its common name but the number of its food-plants has been extended until it is now nearly omniverous. The flowers and leaves of the grape are relished by it but the leaves of the apple, pear, plum, cherry and leaves of many other plants are greedily eaten as well as young fruits.



The rose chafer, "a" larva; "f" pupa; "b, e, g, h," structural details.

The rose-chafer appears in Oklahoma in May and begins feeding voraciously and continues for from four to six weeks. During this time each female lays from one to two dozen eggs, singly, in the soil. Soon the eggs hatch and the larva begin feeding on the young grass rootlets if such are in reach. If not then the rootlets of other plants that are within reach. In autumn the larva have reached maturity, when they are yellowish in color with a brownish head. They descend to below the frost line; come near the surface in early spring, pupate, and soon emerge as perfect beetles to begin again the cycle of life. The insect prefers a light sandy sod soil for a breeding ground, so that if the grape growers guard their vineyards against this condition it will be a good preventive measure.

Remedies.—The beetle can not be easily poisoned. Hand picking twice a day, from the first appearance and as long as the beetles last, may be practicable. Coaxing poultry with wheat to where the insects are and then jarring them onto the ground may be a means of getting rid of the pest.

### GRAPE-BERRY MOTH.

This insect passes the winter in the pupa stage concealed in the old leaves. The first brood in the spring feeds on the flowers, leaves and tendrils of the grape and the second one feeds in the young grapes. Infested berries show a round scar on one side. If a berry is cut open, the larva will be found within. When fully grown, it is a little over a fourth of an inch long and dark colored. It comes out of the berry and passes the pupal stage in a piece of a leaf. The expanded moth is a little less than half an inch across. The front wings are mottled bluish and gray and the hind wings dull dark colored. The moth itself does no harm but lays the eggs which hatch into pupae.

Remedies.—From the nature of the case, poisons are of no value for preventing injury from this insect. About the only way of preventing loss from them is to cover each bunch of grapes with a small paper sack, and this method is too expensive to be used extensively. In the fall, all poor fruit and old leaves should be destroyed to prevent the insect from passing the winter in them.

# INSECTICIDES AND FUNGICIDES.

## BORDEAUX MIXTURE.

Copper sulfate (blue vitriol) 4 pounds.
Quicklime (not air slacked) 4 pounds.
Water, to make 50 gallons.

Dissolve the copper sulfate in about two gallons of hot water, contained in a wooden vessel, by stirring, or even better by suspending the sulfate contained in a cheese cloth sack, in a large bucketful of cold water. With the cold water and cheese cloth bag, a longer time is required. Pour the sulfate solution into the barrel or tank used for spraying, and fill one-third to one-half full of water. Slack the lime by addition of a small quantity of water, and when slacked cover freely with water and stir. Pour the milk of lime thus made into the copper sulfate, straining it through a brass wire strainer of about 30 meshes to the inch. Pour more water over the remaining lime, stir and pour into the other; repeat this operation until all the lime but stone lumps or sand is shaken up in the milk of lime. Now add water to make 50 gallons in the tank. After thorough agitation the mixture is ready to apply. The mixture must be made fresh before using, any left over for a time, should be thrown out or fresh lime added.

## AMMONIACAL SOLUTION OF COPPER CARBONATE.

Copper carbonate, 6 ounces.
Ammonia, about 3 pints.
Water, 50 gallons.

Dissolve the copper carbonate in the ammonia and add the water.

Caution. Use no more ammonia than is required to dissolve the copper carbonate. Ammonia is variable in strength, and the amount required must be tested in practice.

To make copper carbonate: Dissolve 10 pounds copper sulfate (blue vitriol) in 10 gallons of water, also 12 pounds carbonate of soda in same quantity of water. When cool mix the two solutions slowly, stirring well. Allow the mixture to stand twelve hours and settle, after which pour off the liquid. Add the same quantity of water as before, stir and allow to stand the same length of time. Repeat the operation again, after which drain and dry the blue powder, which is copper carbonate.

### POTASSIUM SULFID.

Potassium Sulfid (liver of sulfur) 3 ounces.
Water, 10 gallons.

This solution is valuable for the gooseberry and other powdery mildews, for which it seems even more effectual than Bordeaux mixture, although its effects are less lasting. It does not discolor the fruit and is quite harmless.

### PARIS GREEN.

Paris Green, 1 pound.
Water, 100-200 gallons.

For the destruction of insects that eat the foliage or fruit, Paris Green is a valuable remedy. It can be used in water in the above proportions, the stronger mixture being used for potatoes, while for fruits it is seldom advisable to use more than 1 pound in 200 gallons of water, unless in connection with lime water or Bordeaux mixture. It is always advisable to first form a paste with a small amount of water before preparing it for spraying. For low plants Paris Green may be used in a powder form, either alone or with one hundred times its weight of plaster. London purple is sometimes used in place of Paris Green, but it is more apt to injure the foliage.

### KEROSENE EMULSION.

Dissolve one-half pound hard soap in one gallon of water (preferably soft water) and while still hot, remove from the fire and add two gallons of kerosene. When soft soap is used, take equal quantities of soap and oil and omit the water before mixing. Stir the mixture violently by driving it through a force pump back into the vessel, until it becomes a creamy mass that will not separate. This requires usually from five to ten minutes. The emulsion is then ready to be diluted with water and applied. For the common scale insects and hard bodied insects, like the chinch bug, use 1 part emulsion to 8 or 10 parts water. For soft bodied insects (plant lice, etc.) use 1 pint emulsion to 15 or 20 parts water.

Kerosene emulsion kills by contact and therefore the application should be very thorough. It may be used against a great many different pests, but is especially valuable for destroying those with sucking mouth-parts, for they cannot be killed with arsenical poisons.

### HELLEBORE.

Fresh White Hellebore, 1 ounce.
Water, 5 gallons.

Hellebore is often employed in cases where arsenical poisons would be objectionable. For insects that chew, and especially for the currant and cabage worms.

### PYRETHRUM OR BUHACH.

Pure fresh Pyrethrum, 1 ounce.
Water, 5 gallons.

Valuable against both chewing and sucking insects, especially upon maturing fruits or vegetables, and upon flowering plants. It can also be applied in a powder form with a bellows.

### CAUTION.

The copper solution should be made in wood, glass or earthen vessels, and should not be prepared in iron or tin.

Care should be taken against spraying plants of any kind with lime or poisonous mixtures within four or five weeks of the time they are to be used as food.

Study carefully the nature of the insect or disease and select the remedy that is most likely to destroy it without injuring the plants.

Do not spray while the trees are in blossom as the bees will be destroyed; they help to fertilize the flowers.

Pumps for the application of insecticides and fungicides should be sufficiently powerful to cover the trees or plants with a fine mist, and where copper compounds are to be used, the working parts should be of brass, and if all portions that are to come in contact with the spraying mixture are of brass, the durability of the pump will be greatly increased.

## STOCK FEEDING.

*F. C. Burtis.*

It is generally conceded that stock husbandry is the most profitable branch of farming, and that for agriculture to be on a substantial and profitable basis in a given locality, enough stock should be kept on every farm to consume the greater part of the products produced there. Still it is a fact that many thousands of dollars are lost every year in Oklahoma upon poor stock and through improper methods of feeding. This is not any more true here than in many other localities. Oklahoma has made rapid progress in the stock industry, but there is still much room for improvement. At the present time too much of the stock of Oklahoma is shipped out to be finished eleswhere. With her mild winters, and great variety of feeds in abundance, no other section should excel her in the production of the finished article.

But the time has passed when stock feeding can be carried on in an ignorant and haphazard way and afford the feeder much profit. The successful stockman must be able to discriminate between good and poor animals and use the information that is given him on the composition and digestibility of feeds, and be able to combine them in the most economical form so as to produce the best gains or largest yield of products for the feed consumed. In other words he must know something of the science of stock feeding. He should know why a pound of alfalfa, if properly used is worth two to three times as much as a pound of prairie hay, and about four-fifths as much as a pound of bran, or how a ton of cotton seed meal can be made to yield $45 per ton, when corn is worth twenty-eight cents per bushel; or why a number of pounds of a certain mixture of feeds will produce a third more gain in growth than the same number of pounds of a different mixture when fed to the same animal.

For a good many years scientists have been at work solving these problems for the farmer, and of late years the results have been greatly simplified, so that now a school boy can understand them, and the number of farmers that are utilizing the information that is given in the published feeding tables and standards, is increasing rapidly every year, but still the number is not as large as it should be.

### COMPOSITION OF ANIMALS.

The animal body that the farmer is endeavoring to produce is made up of a class of substances very similar to those found in plants, and these are grouped under the heads; water, ash, or mineral matter, fat, and protein or nitrogenous matter. The plant is the source from which the animal obtains these ingredients with the exception of water and that only in part comes from the plant.

### COMPOSITION OF FEEDS.

In addition to the four groups of substances water, ash, protein and fat, which are found both in animals and plants, there is an additional group, called carbohydrates, found only in plants.

*Water.* From 40 per cent to 60 per cent of the animal body consists of this, and it is found in all feed stuffs, varying in amount from 10 per cent to 90 per cent. Dry clover hay contains about 20 per cent, field cured corn stover 40 per cent and sugar beets 90 per cent. As a rule the water in the feed has no more value than the water from the well, and generally the higher the water content of a feed, the less its value per ton, but there are times when a little succulent feed'as silage or sugar beets is very important. Aside from this the value of a feed is figured on the water-free content and the water in a feed has no value. The term dry matter is applied to the part of the feed after all the water in it has been driven off by an artificial heat.

*Ash.* This is the part left after burning the plant. It is the source of the mineral matter of the body and as such is important. While there is only a small per cent of it in plants, the ordinary mixtures of feeds contain it in sufficient quantity for the requirements of the animal in the majority of cases. The rough feeds, such as the hays, contain a much larger per cent than the grains. Young pigs fed exclusively on corn will not receive sufficient ash for proper growth. This is one of the very few examples where it may be lacking in sufficient quantity. It is quite essential that it be present in the feed of growing animals in sufficient quantity, as it enters largely into the growth of the skeleton.

*Protein* is a name applied to a group of substances found in plants and animals, and to which great importance is attached, because they are the only substances in plants and animals that contain nitrogen, hence the term nitrogenous group that is sometimes applied to them. The white of egg and casein of milk are good examples of animal matter belonging to this group, and the gluten of wheat is an example of vegetable matter. All feeds contain some protein, but some a much larger per cent than others. Most of our common feeds raised on the farm are deficient in it, and do not furnish the proper amount to give the best results in feeding. Protein in the feed is used by the animal system in forming milk, wool, muscle, and hair, and in fact all the working machinery of the body and all other substances containing nitrogen, and is absolutely indispensable in the formation of these as no other substance can take its place, no matter in what quantities furnished. Hence protein is very essential in the feeds of growing animals and others, whose functions or work require the formation of the above products.

Such feeds as cotton seed meal, linseed oil meal, and soy bean meal are very rich in protein, cotton seed, bran, clover hay and alfalfa are moderately rich in it, while Kafir and corn stover, prairie hay, and millet hay contain only very small per cents. The above is the reason why such feeds as cotton seed meal, linseed meal, etc., command high prices on the market; as it is generally the per cent of digestible protein that a feed contains that determines its feeding value.

*Carbohydrates,* comprise a group of substances rich in the element carbon. As was noted this group does not appear in the animal body. In the plant it constitutes the fiber, sugar, starch, and gums and similar substances. The function of carbohydrates in the animal body is to furnish heat, energy, and to build up the fat of the body. All our common feeds contain it in large quantities, and of the rough feeds as hay and fodders, over 90 per cent of the digestible portions are carbohydrates, and all feeds contain a much larger per cent of them than of any other ingredient. Present in such abundance it is a cheap article in the food and the feeder does not need to concern himself much about it only to see that it is present in the proper proportion with the protein.

*Fat.* The form in which this appears in the body is familiar to every one. It is stored up there for future use by the animal system. In the plants it is the fatty matter, as oils and some of the gums. It is so similar to the carbohydrates in composition and the function it performs that it might have been considered under that head. It is, however, more easily utilized by the system than the carbohydrates and it has been found to be worth 2 1-4 times as much for the animal's use. So, in finding the value of a feed the fat is multiplied by 2 1-4 and added to the carbohydrates.. In the feeding tables the fat and carbohydrates are combined in this way and given in one column.

### UNDERSTANDING FEEDING TERMS.

There has been some difficulty with farmers grasping the meaning of some of these terms because they are new to them, but there should not be as they are as simple as the word "water" and carry as much meaning. In practical work one does not think of the elements that go to make up water, and neither is it necessary with these terms. Think of protein for instance as the name of a group of substances found in feeds and realize the part it plays in the animal organism, and that nothing else can be substituted for it. Animals will die without water and will not make the proper growth without enough of it; the same is true of protein. When the farmer looks at these terms in this way he will have no more trouble in comprehending them.

### TERMS USED IN FEEDING.

The scientist has found that for the proper and most rapid growth of animals, or the largest production of milk, wool, etc., the foregoing substances which are called food nutrients, must be present in the food of animals in certain proportions; these proportions vary with the age of the animals and the uses to which they are put.

Now the balanced ration that the farmer has heard more or less about, is nothing more than a ration in which the feeds are so mixed as to furnish these food nutrients in the proper proportions and amounts. The nutritive ratio of a feed is an expression of the relation of the digestible protein contained to the digestible carbohydrates and fat equivalent, and is determined by multiplying the fat by 2 1-4 and adding it to the carbohydrates, and dividing the sum by the number of pounds or per cent of protein. This designates how many pounds of carbohydrates and fat equivalent there are to each pound of protein. For instance if the sum of the carbohydrates and fats divided by the protein equaled 6, it would mean that there was one pound of the latter to every 6 lbs of the former and would be expressed 1:6. The nutritive ratio is spoken of as being wide, or narrow, and the same terms are applied to a ration. The terms have reference to the proportion of the protein to the carbohydrates and fat. For example, in alfalfa where there are 3.8 lbs. of carbohydrates and fat for each pound of protein, the nutritive ratio is very narrow and in corn stover where there are about 20 lbs. of carbohydrates to each pound of protein the nutritive ratio is very wide.

### FEEDING STANDARDS.

The results as determined by scientists as to how much of the different food nutrients animals must have under different conditions, have been tabulated and are called feeding standards. They are not given as inflexible rules but as guides to the farmer and will need altering in cases. These are given in table one. Column one, designated dry matter, is given to aid the feeder in giving the proper bulk of food to the animal. It includes all the feeding ingredients minus the water. The figures given in the various columns are given for animals of a certain weight but may be calculated to animals of any weight. (Page 139)

### DIGESTIBILITY OF FEEDS, AND FEEDING TABLES.

Not all the ingredients in a feed are digested, and as only the digested portions can be utilized by the animal system, in feeding tables only the per cent of digestible ingredients, the portion of value to the animal, is given. These per cents have been determined after many actual feed-trials with the work of the chemist. The results given are the averages of many determinations and of feeds in normal condition. If feeds are neglected and left to bleach in the weather or become damaged otherwise they will not contain nearly as high a feeding value as is given in the table. Table two gives the digestible nutrients of feeds in the reach of Oklahoma farmers. The only explanation that the table needs is that the work of combining the fats and carbohydrates has been performed and the result placed under one column. (Page 140.)

### MIXING FEEDS ACCORDING TO FEEDING STANDARDS.

First, the feeder must refer to the feeding standards and find under what class the animal comes that he has to feed and what proportion and amount of the food nutrients are required. Is it an animal that requires a larger proportion of protein or not? If it is he must count on using some food rich in protein. The feeder should select feeds within his reach and those that he thinks will give the desired results, always giving due consideration to the market value of each. Determine the number of pounds of the feeds that the animal should have, and then refer to table two of digestible nutrients and figure out the pounds contained in each feed selected. Compare the totals with the numbers found required for the animal according to the feeding standard. If the ration does not furnish the nutrients in the required proportion and amounts, reduce the feed that does not seem to furnish enough protein, or vice versa, and add one that contains more protein or less carbohydrates. Continue this adjustment until the digestible nutrients in the ration approximate those required in the standard, and the ration would be said to be a balanced ration and the nutritive ratio a proper one. The following example may help to make the method clear. A bunch of steers, averaging 900 pounds are to be fattened. Calculate the ration per head and per day. Referring to the feeding standard to get the nutrients, we find that for a 1000 lbs. steer, is required dry matter 27 lbs., protein, 2.5 lbs., carbohydrates and fat equivalent 16.1 subtracting 10 per cent from each one of these as the steer is 10 per cent lighter than the one given in the standard, we have the following: Dry matter 24.3 lbs., protein 2.25 lbs., carbohydrates and fats 14.49 lbs. Take a common ration for a steer of this size, 24 lbs. corn and 12 lbs. corn stover. Referring to the feeding tables we find the following for the corn:

Dry matter per cent 8.91x24 equals 21.36 lbs.
Protein per cent 7.9x24 equals 1.89 lbs.
Carbohydrates and fat 76.4x24 equals 18.33 lbs.

The same table gives us for corn stover:

Dry matter per cent 59.5x12 equals 7.20.
Protein per cent 1.7x12 equals .204.
Carbohydrates and fat 32.4x12 equals 3.9.

Tabulating the above we have the following:

| | Dry Matter—lbs. | DIGESTIBLE: | | Nutritive Ratio |
|---|---|---|---|---|
| | | Protein—lbs. | Carbohydrates and fat—lbs. | |
| 24 lbs corn contains | 21.36 | 1.89 | 18.33 | 1: 9.7 |
| 12 lbs. corn stover | 7.2 | .204 | 3.9 | 1:19.9 |
| Total contained | 28.56 | 2.1 | 22.23 | 1:10.6 |
| Required amount | 24.3 | 2.25 | 14.49 | 1: 6.4 |

The important points to notice are that the protein lacks practically 1-4 lb., and the carbohydrates are about 8 lbs. too much, which makes 10.6 lbs. of carbohydrates to each pound of protein when there should be only 6.4 lbs. The dry matter should be at least two pounds less. With the nutrients in this proportion the steer would not make as rapid gains and it would take more pounds of feed to make a pound of gain than if the proportion of protein was nearer the carbohydrates.

The ration could be remedied as follows: Reduce the corn to 14 pounds and add 4 pounds of cotton seed, reduce the corn stover to 5 pounds and add 6 pounds of alfalfa hay. Referring to table two for the per cent of digestible nutrients in these feeds and making the computations as before we have the following:

| | Dry Matter | Digestible: | | Nutritive Ratio |
|---|---|---|---|---|
| | | Protein | Carbohydrates and fats | |
| 14 lbs. corn | 12.46 | 1.106 | 10.69 | 1: 9.7 |
| 4 lbs. cotton seed | 3.58 | .5 | 1.2 | 1: 5.9 |
| 5 lbs. corn stover | 3 | .085 | 1.72 | 1:19.9 |
| 6 lbs. alfalfa | 5.52 | .66 | 2.53 | 1: 3.8 |
| Total | 24.56 | 2.351 | 16.14 | 1: 6.8 |
| Required amount | 24.3 | 2.25 | 14.49 | 1: 6.4 |

Both the protein and the carbohydrates are a little too high and the nutritive ratio a trifle wide, but near enough for practical purposes. On this ration the steer would make larger gains and on less grain per day.

The following comparison taken from the steer feeding experiments of the past winter at this Station will illustrate the value of an approximate balanced ration as compared with one carrying too large a proportion of carbohydrates, known as a wide ration.

Five steers were fed on corn meal and alfalfa hay and five on corn meal and Kafir corn stover. Taking the average number of pounds of feed per day and per head and determining the nuturients in each, we have the following:

| | Dry Matter | Digestible: | | Nutritive Ratio |
|---|---|---|---|---|
| | | Protein | Carbohydrates and fat | |
| 17.84 lbs. corn meal | 15.88 | 1.36 | 13.62 | |
| 12.87 lbs. alfalfa hay | 11.84 | 1 39 | 5.33 | |
| Total | 27.72 | 2.75 | 18.95 | 1: 6.9 |
| 18.67 lbs. corn meal | 16.61 | 1.47 | 14.26 | |
| 10.33 lbs. Kafir corn stover | 8.35 | .15 | 4.52 | |
| Total | 24.96 | 1.62 | 18.78 | 1:11.6 |
| Standard required | 29.7 | 2.75 | 17.71 | 1: 6.4 |

The nutrients given as required are for a 1100 lb. steer. The steers were fed all the alfalfa hay and Kafir stover they would eat and more or less waste was left, but only the actual amount that they did eat was considered in the ration. The corn meal alfalfa fed steers required

30 1-2 per cent less grain to produce a pound of gain, and gained .53 of a pound more per head each day, than the corn meal Kafir stover fed steers.

The fact should not be overlooked that there are cases where the balanced ration is not the most economical. This will be influenced by the relative market price of feeds and the animals that are to be fed. For instance if corn is very cheap the feeder will not be justified in paying high prices for mill stuff to feed in very large quantities to fattening steers, unless it be for the finishing period. The carbohydrates that he would waste are too cheap in 15 cent corn to justify him to buy high priced protein to save them. But generally, feed containing enough protein at a reasonable price can be had on the farm at a price that will justify an approximate balanced ration in the majority of cases. Besides the loss of food nutrients, there are detrimental results caused by an unbalanced ration. Growing stock are stunted; dairy cows are dried up, in breeding stock the animal system is weakened, etc. For such cases as these the balanced ration will pay even if it is necessary to purchase such feeds as oil meal, etc., that are generally considered high priced.

## SOME OKLAHOMA FEEDING STUFFS.

### COTTON SEED AND ITS PRODUCTS.

The cotton plant furnishes some very valuable food products.

The seed is quite rich in protein and contains some 3 1-2 pounds more per hundred than corn. The use of it could be greatly increased with profit among farmers. It is not practical to feed it to hogs as it requires special preparation for them, but gives the best results when mixed with corn and fed to cattle.

Cotton seed meal, the product from the oil mills, is very rich in protein; in fact contains more protein than any other feed. All stock relish it and do well on it when mixed with other feeds, but it must be fed with great precaution to hogs, as after four weeks feeding on it, they commence dying. This Station has been successful in feeding it to hogs without fatal results, by discontinuing the cotton seed meal after four weeks feed, for about two weeks, and then adding the cotton seed meal again for four weeks and so on.

Dairy cows should not be fed more than 2 to 3 pounds of it per day, and steers not more than six to eight for the best result. Steers when fed large qunatities longer than 80 to 90 days go blind.

Cotton seed hulls are a dry and tasteless article of low feeding value, but have a value to the feeder as they can be readily mixed with various meals to be fed to cattle, and furnish that divisor that is so necessary with such heavy foods as meals.

### COWPEAS.

While the grain of this plant contains a rather large per cent of protein, it is not economical to try and harvest it separately for feeding, but the whole plant should be utilized as hay or pastured off in the field. In this condition, it is much richer in protein than our common rough feeds and makes a valuable addition to them to help balance the ration.

### SOY BEANS.

This plant should be grown for the grain it produces as it contains about 30 per cent of protein, and is relished by all stock and can be fed to them with other grain, in proper proportions, with great profit.

The plant has little value as hay but its erect growth enables it to be harvested for the grain with machinery. The plant does well in Oklahoma.

### WHEAT BRAN.

This feed can generally be purchased at a price to justify quite an extensive use of it. It is valuable for the protein it contains and other beneficial effects on the animal system. It is very valuable to mix with feed for breeding stock.

### ALFALFA.

This is one of the most valuable feeds grown on the farm and it does well quite generally over Oklahoma. Besides being a very palatable feed, it contains almost as much protein as bran and will give about as good results in feeding. This makes it quite a valuable crop when we consider that three to four tons of hay per acre can be harvested yearly. It is relished by all stock and it is a very economical feed to put in to balance the ration. Even the dry hay is eaten by swine and much better gains are obtained where it is fed in addition to corn, than where corn alone is fed. This is especially true with shoats.

### SUGAR BEETS AND MANGLES.

As a source of succulent feed in the winter, these are very valuable. In Oklahoma where green pasture can be had the winter through, they are not as essential as in the north. At no time should breeding stock be without succulent food as part of the ration at least. When the brood sow has not access to pasture, a sugar beet or two a day will go a great way towards bringing a healthy litter. For stock feeding beets and mangles can be raised successfully in Oklahoma.

### CORN.

This is pre-eminently the American stock food. Besides carrying a fair amount of protein, there are in every 100 lbs., 76.4 lbs. of digestible carbohydrates and fat equivalents, with the protein making a total of 84.3 lbs. food nutrient equivalents in each one hundred pounds of grain. It is a highly carbonaceous feed and in the majority of cases some feed richer in protein should be mixed with it to give the best results.

### KAFIR CORN.

While superior to corn as a plant to grow on poor soil and to resist drouth, it is not equal to corn in feeding value. It is very similar to corn in composition but it is not nearly as digestible. It should be ground in the majority of cases to obtain the best results.

### TABLE I—FEEDING STANDARDS. A—*Per Day and 1,000 lbs. Live Weight-*

| ANIMAL | Dry Matter | DIGESTIBLE: | | | Nutritive Ratio |
|---|---|---|---|---|---|
| | | Protein | Carbohydrates | Total | |
| HORSES— | | | | | |
| Light work | 20 | 1.5 | 10.5 | 12 | 1:6.9 |
| Medium work | 24 | 2 | 12.35 | 14.35 | 1:6.2 |
| Heavy work | 26 | 2.5 | 15.3 | 17.8 | 1:6 |
| FATTENING CATTLE— | | | | | |
| Preliminary period | 30 | 2.5 | 16.1 | 18.6 | 1:6.5 |
| Main period | 30 | 3 | 16.1 | 19.1 | 1:5,4 |
| Finishing period | 26 | 2.7 | 16.6 | 19.3 | 1:6.2 |
| MILCH COWS— | | | | | |
| When yielding daily 11.0 lbs. of milk | 25 | 1.6 | 10.7 | 12.3 | 1:6.7 |
| 16.6 lbs. of milk | 27 | 2 | 12 | 14 | 1:6 |
| 22 lbs. of milk | 29 | 2.5 | 14.1 | 16.6 | 1:5.7 |
| 27.5 lbs. of milk | 32 | 3.3 | 15 | 18.3 | 1:4.5 |
| SHEEP— | | | | | |
| Coarse wool | 20 | 1.2 | 11 | 12.2 | 1:9.1 |
| Fine wool | 23 | 1.5 | 12.7 | 14.2 | 1:8.5 |
| Breeding ewes | 25 | 2.9 | 16.1 | 19 | 1:5.6 |
| FATTENING SHEEP— | | | | | |
| First period | 30 | 3 | 16.1 | 19.1 | 1:5.4 |
| Second period | 28 | 3.5 | 15.9 | 19.4 | 1:4.5 |
| FATTENING SWINE— | | | | | |
| First period | 36 | 4.5 | 26.5 | 31 | 1:5.9 |
| Second period | 32 | 4 | 25.1 | 29.1 | 1:6.3 |
| Third period | 25 | 2.7 | 19 | 21.7 | 1:7 |
| BROOD SOWS | 22 | 2.5 | 16.5 | 19 | 1:6.6 |

### TABLE I—FEEDING STANDARDS. B.—*Per Day and Head.*

| ANIMAL | Age—months | Average Live Weight per Head | Dry Matter | DIGESTIBLE: | | | Nutritive Ratio |
|---|---|---|---|---|---|---|---|
| | | | | Protein | Carbo-hydrates | Total | |
| Growing Animals | 2– 3 | 150 | 3.3 | .6 | 2.8 | 3.4 | 1:4.6 |
| | 3– 6 | 300 | 7 | 1.0 | 4.9 | 5.9 | 1:4.9 |
| | 6–12 | 500 | 12 | 1.3 | 7.5 | 8.8 | 1:6 |
| | 12–18 | 700 | 16.8 | 1.4 | 9.7 | 11.1 | 1:7 |
| | 18–24 | 850 | 20.4 | 1.4 | 11.1 | 12.5 | 1:8 |
| Growing Sheep | 5– 6 | 56 | 1.6 | .18 | .974 | 1.154 | 1:5.4 |
| | 6– 8 | 67 | 1.7 | .18 | .981 | 1.161 | 1:5.4 |
| | 8–11 | 75 | 1.7 | .16 | .953 | 1.113 | 1:6 |
| | 11–15 | 82 | 1.8 | .14 | .975 | 1.115 | 1:7 |
| | 15–20 | 85 | 1.9 | .12 | .955 | 1.075 | 1:8 |
| Growing Fat Swine | 2– 3 | 50 | 2.1 | .38 | 1.5 | 1.88 | 1:4 |
| | 3– 5 | 100 | 3.4 | .5 | 2.5 | 3 | 1:5 |
| | 5– 6 | 125 | 3.9 | .54 | 2.96 | 3.5 | 1:5.5 |
| | 6– 8 | 170 | 4.6 | .58 | 3.47 | 4.05 | 1:6 |
| | 8–12 | 250 | 5.2 | .62 | 4.05 | 4.67 | 1:6.5 |

## TABLE II.—DIGESTIBLE NUTRIENTS IN FEEDING STUFFS.

*Pounds in 100 lbs. of Feed.*

|  | Dry Matter | DIGESTIBLE: |  |  | Nutritive Ratio |
|---|---|---|---|---|---|
|  |  | Protein | Carbohydrates and Fats | Total |  |
| CONCENTRATES. |  |  |  |  |  |
| Corn | 89 | 7.9 | 76.4 | 84.3 | 1: 9.7 |
| Wheat | 90 | 10.2 | 73 | 83.2 | 1: 7.2 |
| Wheat Bran | 88 | 12.2 | 45.3 | 57.5 | 1: 3.7 |
| Wheat Shorts | 88.2 | 12.2 | 58.5 | 70.7 | 1: 4.8 |
| Brewer's Grain, wet | 24 | 3.9 | 12.5 | 16.4 | 1: 3.2 |
| Brewer's Grain, dry | 92 | 15.7 | 47.8 | 63.5 | 1: 3 |
| Oats | 89 | 9.2 | 56.8 | 66 | 1: 6.2 |
| Sorghum Seed | 87.2 | 7 | 59.1 | 66.1 | 1: 8.4 |
| Broom-corn Seed | 85.9 | 7.4 | 54.8 | 62.2 | 1: 7.4 |
| Kafir Corn, whole | 87.5 | 4.7 | 32.6 | 37.3 | 1: 6.9 |
| Kafir Corn, coarsely ground | 87.5 | 5.8 | 56.5 | 62.3 | 1: 9.8 |
| Kafir Corn Heads | 78.4 | 1.03 | 21.5 | 22.5 | 1:20.9 |
| Millet | 86 | 8.9 | 52.2 | 61.1 | 1: 5.9 |
| Flaxseed | 90.8 | 20.6 | 82.3 | 102.9 | 1: 4 |
| Linseed Oil Meal, old process | 91 | 29.3 | 48.5 | 77.8 | 1: 1.7 |
| Cotton Seed | 89.7 | 12.5 | 68.9 | 81.4 | 1: 5.5 |
| Cotton Seed Meal | 92 | 37.2 | 44.4 | 81.6 | 1: 1.2 |
| Cotton Seed Hulls | 88.9 | .3 | 36.9 | 37.2 | 1:12.3 |
| Sunflower Seed | 92.5 | 12.1 | 85.8 | 97.9 | 1: 7.1 |
| Peanut Meal | 89.3 | 42.9 | 38.3 | 81.2 | 1: 0.9 |
| Peas | 90 | 16.8 | 53.4 | 70.2 | 1: 3.2 |
| Soy Beans | 89.2 | 29.6 | 54.9 | 84.5 | 1: 1.8 |
| Cowpeas | 85.2 | 18.3 | 56.7 | 75 | 1: 3.1 |
| ROUGHAGE. |  |  |  |  |  |
| Fodder Corn, field cured | 58 | 2.5 | 37.3 | 39.8 | 1:14.9 |
| Corn Stover, field cured | 60 | 1.7 | 34 | 35.7 | 1:19.9 |
| Kafir Fodder | 90.3 | 2.1 | 53.49 | 55.6 | 1:24.9 |
| Kafir Stover | 80.8 | 1.5 | 45.3 | 46.8 | 1:29.6 |
| Red Clover, medium | 84.7 | 6.8 | 39.6 | 46.4 | 1: 5.8 |
| Red Clover, mammoth | 78.8 | 5.7 | 36.3 | 42 | 1: 6.4 |
| Alfalfa | 92 | 11 | 42.3 | 53.3 | 1: 3.8 |
| Cow Pea Hay | 89.3 | 10.8 | 41.1 | 51.9 | 1: 3.8 |
| Soy Bean Hay | 88.7 | 10.8 | 43.1 | 49.5 | 1: 4 |
| Timothy | 87 | 2.8 | 46.5 | 49.3 | 1:16.6 |
| Orchard Grass | 90.1 | 4.9 | 45.4 | 50.3 | 1: 9.3 |
| Redtop | 91.1 | 4.8 | 49.1 | 53.9 | 1:10.2 |
| Mixed Grasses | 87.1 | 5.9 | 43.7 | 49.6 | 1: 7.4 |
| Prairie Grass | 85 | 3.5 | 45 | 48.5 | 1:12.8 |
| Oat Hay | 91.1 | 4.3 | 49.8 | 54.1 | 1:11.6 |
| Oat Straw | 90.8 | 1.2 | 40.4 | 41.6 | 1:33.6 |
| Wheat Straw | 90 | .4 | 37.2 | 37.6 | 1:93 |
| Rye Straw | 92.9 | .6 | 41 5 | 42.1 | 1:69 |
| Barley Straw | 85.8 | .7 | 42.5 | 43.2 | 1:61 |
| ROOTS AND TUBERS. |  |  |  |  |  |
| Potato | 21 | .9 | 16.5 | 17.41 | 1:18.3 |
| Beets, sugar | 13 | 1.1 | 10.4 | 11.5 | 1: 9.4 |
| Mangels | 9 | 1.1 | 5.6 | 6.7 | 1: 5.1 |
| Flat Turnip | 9.5 | 1 | 8.5 | 9.5 | 1: 8.5 |
| Artichokes | 20 | 2 | 17.2 | 19.2 | 1: 8.6 |
| MISCELLANEOUS. |  |  |  |  |  |
| Pumpkins | 9.1 | 1 | 6.5 | 7.5 | 1: 6.5 |
| Rape | 14 | 1.5 | 8.5 | 10 | 1: 5.7 |
| Milk | 12.8 | 3.6 | 13.2 | 16 8 | 1: 3.7 |
| Skim Milk | 9.6 | 3.1 | 6.5 | 9.6 | 1: 2.1 |
| Buttermilk | 10 | 3.9 | 6.5 | 10.4 | 1: 1.7 |
| Whey | 6.6 | .8 | 5.4 | 6.2 | 1: 6.7 |

# Reprints From the Tenth Annual Report.

## SUMMARY OF PRESS BULLETINS

## 1900-1901.

### PASTURE CROPS FOR HOGS.

Pasture and range are necessary in order to keep breeding swine in a healthy condition and grow the stock at a profit. The man who tries to raise swine under other conditions is playing a losing game, and his balance will be on the debtor side of the ledger just as sure as we have day and night. Although these facts have been vouched for many times by Experiment Stations and successful swine raisers and given wide publicity, thousands of farmers still continue in trying to raise hogs in a dry lot with nothing but corn as a feed, with the expectations of making it a profitable operation.

A hog pasture does not mean a dust lot with possibly a few old weeds off in one corner, but a good and commodious range, and if planned to give the best results, it will contain a variety of crops, selected as to their food value. The pasture should not be so small that the hog is compelled to eat his own filth to get the feed. Every farm should have six to eight acres of hog pasture fenced purposely for this use. This is in addition to what range may be utilized outside at times. Better far to have a little too much than not enough. If the crop gets ahead of the hogs and becomes woody cut it off with the mower and a new growth will start. This can be done with many plants and will pay even if the mowed portion is not gathered. The pasture may be greatly fertilized by this method in many cases. The enclosure should be divided into two or three parts, at least, so that while one part is being pastured, crops may be growing in the others.

While succulent food is very essential the year round for growing and breeding stock, the exercise is just as necessary. Pigs confined in pens will do much better if they have some green feed, but the results will be vastly better if the pigs are allowed a range and the chance to gather this feed for themselves.

Any green crop is much better than no pasture, but some crops for this purpose are very much superior to others, and a variety of crops, even though they may be much alike in composition, is superior to a single crop. Many swine raisers that appreciate the value of a hog pasture do not realize the importance of giving attention to variety and composition of the plants to be used.

In selecting the crops for a hog pasture consider the composition of the plants as you would consider the composition of the grain in a ration. Bear in mind that certain crops are rich in the food nutrient protein, that is so essential in the animal system to build up the frame and muscles, and is very necessary in the food of breeding stock. Crops of the opposite nature are rich in carbohydrates, the heat and fat forming compounds.

Endeavor to have some of the former to pasture along with latter and the results will be better. Plants belonging to the former group, those that are especially rich in protein, are alfalfa, clover, field peas, cowpeas, soy beans, vetches and peanuts. Rape, sorghum, the cereals, sweet potatoes and artichokes belong to the opposite group. Aside from being especially valuable for food, the cowpea group adds greatly to the fertility of the soil while growing on it, and will give paying yields on soil too poor for other crops. While a wheat pasture, or a sorghum pasture perhaps is of great value the results will be much more satisfactory if cowpeas or some like crop can be pastured at the same time.

In selecting the crops, due attention should be paid to the point of having a succession of crops that will furnish green feed at all times. Drouth resisting crops should be included for the drouthy time of year. Some crops with proper handling will furnish feed almost the year round while others are suitable for only one of the seasons, or a part of two.

In this list of crops for hog pasture, alfalfa, wheat, rye and oats will not be taken up in full.

Where alfalfa can be grown successfully, it has no equal as a pasture crop for hogs and it furnishes a large amount of feed almost the year round when handled properly.

But about nine men in ten that use it for that purpose ruin it by too close pasturing and at improper times.

Wheat, oats and rye are standard crops for this purpose and may be so grown as to furnish green feed for almost the whole year. But many times they are overpastured and pastured too late when the crop is to be left for grain. In both of these cases other crops should be furnished to prevent the over-pasturing and at improper times.

In addition to the above named crops that may be utilzed for this purpose, should be mentioned field peas, rape and vetches.

The field pea belongs to the cowpea class and is suitable to a cool, moist climate and will withstand a hard frost, so should be seeded early in March. Broadcast a bushel and a half of peas, plow under four or five inches and harrow down and then seed a bushel and a half of oats on top of this.

The peas are ready to pasture when they start to bloom. The seed costs from $1.50 to $2.00 per bushel which will keep many from growing them. It is well to see if a more suitable crop is not available, but field peas are worthy of a trial in this country. The yield of oats and peas the past season on the Station farm was 15 tons per acre. Fair results have been obtained from fall seeding on the Station farm.

The rape plant makes the best of spring pasture. It is a plant that furnishes, under fairly favorable conditions, a large amount of green feed in a short time from planting. The color and texture of the leaves resemble cabbage, but it grows two or three feet tall and has no value only in the green stage. It is grown over a wide territory and under varying conditions but adapted to moist, cool weather and a good, rich soil. For a time it was thought suited only to the Northern states and Canada, but gradually it is working South and has given very favorable results in Oklahoma and should be tried by all hog and sheep raisers.

The following results were obtained on the Station farm the past season:

| | Tons per acre. |
|---|---|
| Rape, drilled, rows 30 inches | 23.5 |
| Rape, drilled, rows 6 inches | 11. |
| Rape, drilled with oats | 12.5 |

The seeding was made the last week in March and the yields determined June 2nd. The plots were on well-manured land.

For this country the seeding should be made early in March. The hot dry weather of August has stopped the growth here, and the June seeding for fall pasture as advised by some will give very uncertain results as will the seeding in corn just before the last cultivation. Such methods may give fair results at times of much rain fall. It is a plant that stands a great deal of cold and frost.

Seedings made on the Station farm last fall have lived through the winter and the plants are making an early spring start. The fall growth was rather small. Both broadcasting and drilling for cultivation are practiced. For this country, if much dependence is put upon the crop, drilling in rows to admit of cultivation is recommended. Planted in this way it will stand the drouth much better and if pastured and cultivated properly, the period of growth may be greatly extended, and much more feed obtained. A good rich soil is more essential where broadcasting is employed.

For broadcasting, three to five lbs., of seed per acre should be used. For drilling in rows 30 inches apart, one or two pounds should suffice. The poorer the soil and the more unfavorable the conditions, the more seed necessary.

The plants reach their maximum growth in 6 to 10 weeks from seeding but pasturing may commence as soon as the plants are firmly rooted. Sheep or hogs do not like the plants at first, but by limiting their other feed, they will eat it, and when they have acquired a taste for it they eat it greedily. Care must be taken in turning sheep on it to avoid bloating. There will be several successive growths if the plants are not pastured or cut closer than 4 inches from the ground. The seed costs about 10 cents per lb. in small quantities. The Dwarf Essex variety should be used.

Rape and field peas, and rape and oats make fair mixtures for seeding.

The following may be considered summer and fall pastures: Sorghum, cowpeas, peanuts, sweet potatoes and artichokes.

Sorghum is the most reliable and largest producer of pasture for summer. While it furnishes a large amount of green feed per acre, it is highly carbonaceous, and should be pastured along with cowpeas for best results.

Its culture is well understood. Seedings may be made from spring to late summer. It will always be found a standby during drouths. While broadcasting is the common way of seeding for hog pasture, it is always advisable to drill and cultivate some as this will make better feed in a case of severe drouth. And when grown this way the sugar content is much greater and any stalks left will make good winter feed for hogs. In selecting the seed, the sugar bearing varieties should be chosen and seeded thinner on the ground than when the crop is grown for hay. Sorghum may be seeded with oats in the spring with good results. The sorghum continues after the oats are gone.

Cowpeas make a good twin brother to sorghum for hog pasture. The peas furnish the nitrogenous material that the sorghum lacks. Cowpeas are great drouth resisters and admit of many ways of planting and over a large season. Seeded on ground from which a crop of oats or wheat have been removed, they will produce from 1 1-2 to 2 feet of growth by the first of September. For earlier feed than this they should be seeded the last of April or the first of May.

While broadcasting is a very successful method of seeding them, it is very desirable to drill and cultivate some as this will aid them to withstand drouth, and more feed will be produced at a critical time. For broadcasting about 1.1-4 bushels of seed is required per acre; for drilling in rows 30 inches apart, three pecks.

Peanuts are a crop that do well in Oklahoma, and many are raised for market, but they have greater value to the territory for hog pasture. For hog pasture they can be made to pay on any soil that is open enough to work easily. The hogs harvest them and that expense and labor is saved. Many a peanut crop harvested and marketed at a loss would have yielded a handsome profit if it had been used as a hog pasture. Peanuts should be valued as a protein producer, and for that purpose are very valuable as they contain about 30 per cent of that most valuable food ingredient. While the vines are green they are eaten and afford valuable feed. The crop should be pastured along with sorghum, rye, wheat, or oats for the most profitable results. For hog pasture the crop can be grown as cheaply as corn. Plant as soon as all danger of frost is over. Have the soil in fine tilth. Make the rows two and a half or three feet apart and drop the seed twelve to sixteen inches apart in the row. About two bushels of the nuts in the pod will be required to seed an acre. Give clean culture, and no hilling up is necessary. The Spanish variety is best suited for this purpose.

Sweet potatoes make a good feed for hog pasture. The expense of this crop is quite light up to the time of harvesting and the hogs will do this to perfection and give good returns for value received. The culture of the crop is well understood. It can be made ever profitable utilized as hog pasture.

Artichokes are a most excellent crop to furnish fall and winter pasture for hogs. Under proper treatment 400 to 800 bushels of tubers per acre may be counted on. Plow the ground as you would for potatoes; plant in April in rows three feet apart with the hills fourteen to eighteen inches apart in the row, and cultivate as you would corn. In this country the pasture is available the winter through. (March, 1901).

## NEW AND REMARKABLE PLANTS.

Much money is wasted every year in the purchase of nursery stock that is "the greatest wonder of the age." People keep on buying this sort of things and probably will continue to do so. Some enterprising man, out of a job, perhaps, or possibly because there is money to be made at it, arranges with some grower of nursery stock to fill his orders with the cheapest sort of seedling apple trees. The agent starts out and names it "The everbearing pumpkin apple." Trees are sold for fifty cents or a dollar each, and the purchaser plants the "ever-bearing pumpkin apple tree," watches it closely for four to six years, and at last there are a few blossoms. What delicious "pumpkin apples" will be his! When fall arrives, and a few little, sour apples are all that are secured, there is considerable disappointment, but usually further hopes for future development. If plain, reliable trees of Missouri Pippin, Ben Davis, Winesap, Jonathan, Arkansas Black, Maiden Blush, or any other standard varieties had been planted good fruit would have been secured instead of nothing.

This is but an illustration. The principle holds good in the purchase of seeds and plants of every sort. Purchasing seeds and plants from well-known nurserymen and seedsmen is the best and safest plan. Expectations of a great deal for nothing or of securing something unusually profitable will not be realized. Fruits are mentioned particularly because of the frequency of deception in tree-selling and of the ease with which profitable, thrifty, reliable, nursery stock may be secured. (February, 1901).

## CHINCH BUGS.

On September 17, 1900, a circular was sent out from the Experiment Station to over four hundred wheat growers of the territory regarding the prevalence of the chinch bug and the success attending the use of the infection and other methods of destroying this well known pest. Many of these persons had received from the Station during one or more seasons some of the chinch bug infection for trial on their places and it was desirable to collect the statements of these persons as to the results secured by them on a large scale. The following are the questions to which answers were requested:

1. Have you found any chinch bugs this year? During what year did you first notice the bug in your crops?

2. Were they more abundant this year than during preceding years?

3. What did you do with the infection which you received from the Station?

4. Do you consider that the infection has reduced the numbers of chinch bugs?

5. Have you employed any other method of exterminating the bugs?

In answer to these circulars there were received about two hundred and fifty replies of which one hundred and eight came from persons who had employed the infection on their places during one or more years. These hundred and eight replies represent twenty-two of the counties of the territory and two of the nations of the Indian Territory.

In all parts of "Old Oklahoma" the bugs were noticed during the year 1890 or shortly thereafter while in the "Strip" the bugs were present as a rule in the first wheat crop raised. They have been present during each of the following years in greater or less numbers and were present in the wheat and sorghum during the past season in many parts of the territory. According to the replies the bugs were not more numerous this year than during previous years though in a few localities they have done more damage this year than ever before. From the information at hand it is not possible to detect any evidence of migration from one part of the territory to another, though some report that such is the case.

The replies to the fourth question were rather conflicting and are therefore tabulated below for reference:

Yes—50.
No—22.
?——36.
Total, 108.

To the 50 replying "yes" might be added 16 others who answered "yes" but who were for one reason or another in doubt as to their reply. In many cases the experiment had been tried during very dry weather and failed for the very simple reason that at that time or rather under those conditions the fungus was unable to grow as rapidly as required. Experiments tried during wet weather were as a rule successful for under these conditions the fungus is able to vegetate rapidly and the "infection" spreads rapidly. Of course the death of the bugs during moist, damp weather must not be confused with the death due solely to the presence of the infection, and since the greatest damage done by the bugs is during dry weather, when the fungus is unable to grow rapidly, it can hardly be expected that great or paying success will attend the use of the infection on a large scale. The Station will be glad to supply persons with the infection for such use but suggests that it is often possible for the farmer to find a great abundance of the infected dead bugs about the bases of the old corn or sorghum stems.

Very few persons had attempted to make use of any other method for exterminating the bugs. The most important methods suggested in these answers are tabulated for reference:

1. Many have found it wise to burn all the stubble off the ground.

2. Some form of the "barrier" method has in many places been found useful and practical on a large scale.

3. The planting of "catch crops" is highly recommended by many and seems to be worthy of trial in more parts of the territory.

4. One of the correspondents reports that the "lady bugs" were rendering valuable assistance in destroying the bugs.

5. Another person says that the Pekin ducks had eaten many of the bugs on his place. Attempts should be made to induce other domestic fowls to eat the bugs for the rapid destruction of a few when they first appear on a few rows of the crop may save the entire field.

6. Spraying the stems of corn and sorghum with boiling hot water proved satisfactory in some cases though the use of Paris Green and kerosene emulsion proved of no avail.

Experiments along some of the lines mentioned are to be undertaken at the Station during the coming season and in the meantime notes from persons who have had success with any method are very desirable and will greatly assist in combating this great insect enemy. (December, 1900.)

### THE GRAIN-LOUSE VERSUS WHEAT.

It is appropriate at this time to notice this insect whose ravages in wheat in several counties of Oklahoma have greatly reduced the value of this year's crop. By extensive correspondence and by conversations with many wheat growers, uniform testimony is secured that throughout the regions named below the wheat or grain-louse has greatly damaged this year's crop. In fact the injury in some regions has been so great that farmers have preferred to replant the wheat ground to some other crop. A recommendation to this effect was inserted in some of the newspapers of the territory some time ago.

The Station received the first specimens of this louse early in April and the Entomologist has since that time given most of his time to a thorough investigation of the distribution and life history of the insect. It became at once apparent that the main damage was not due to the well known "grain-louse" (Siphonophora avenae), whose structure and life history have been so well aired in the newspapers of late. Our form differs from the one mentioned in several details and will soon be described as a new variety closely related to the true "grain-louse."

The greatest injury to wheat has occurred in the following regions: Chickasaw and Cherokee Nations and Cleveland, Canadian, Kingfisher, Lincoln, Logan, Noble, Oklahoma, Payne, Pawnee and Pottawatomie counties. In some cases it was noted that the general trend of the migrations of the insect was from south to north. The louse, like its better known relative, is capable of very rapid multiplication and this is favored by dry weather. Males are unknown and the reproduction is by the process called parthenogenesis, or the giving birth to the living young. The viviparous females are wingless but enough winged females are produced to enable the species to migrate from one field to another in search of food. These winged females were present in large numbers from about the middle of April to the first of May.

There is no evidence that this louse has a true egg-stage. It is probable that it winters over in the adult stage and feeds upon the leaves of the wheat during favorable weather during the entire winter. The past winter was in some respects very favorable to the development of the louse in large numbers and it is not therefore a matter for surprise that such hordes of lice should have appeared so early in the spring.

There is no practical spraying method that can be recommended against this insect pest. Some have suggested spraying with the usual kerosene emulsion and this would probably reduce their number if applied before they spread over so large an area as to make the plan quite impossible and too costly. Our greatest hope lies, however, in the rapid multiplication and energy of the natural insect enemies of this louse. The most abundant and useful of these enemies in Oklahoma is surely one of the 'lady-bird' beetles (Hippodamia convergens). This is a nearly hemispherical beetle about three-sixteenths of an inch in length and of a reddish-yellow color with several black spots on the back. The head and thorax are black with reddish-yellow margins and the thorax has two elongated reddish-yellow spots.

The larvae of these beetles are even more rapacious and active than the mature beetles. The larva is a long, blackish, somewhat flattened, and very active larva with six legs of more than usual length. The larva when it reaches maturity curls upon some leaf or stem and changes to the pupa from which the mature beetle emerges in a few days. The beetles live over winter in the mature stages in crevices of trees and boards. These "lady-bird" beetles have appeared in such large numbers in some parts of Oklahoma that farmers have written to the Experiment Station for some remedy to destroy them. Every wheat grower should look on these beetles as his best friends and in no case allow them to be destroyed.

Specimens of the wheat louse and especially specimens of all the beetles found in the wheat fields are very much desired by the Experiment Station and may be sent through the mail if enclosed in tin or wooden boxes. (May, 1901.)

# COTTONSEED MEAL AS PIG FEED.

F. C. Burtis.

## INTRODUCTION.

Protein, the nitrogenous part of the feed, is the most important constituent in it. Many of the common feeds on the farm, as corn, Kafir corn, etc., do not contain this ingredient in sufficient amount for the best results in feeding. A feed is generally valuable in proportion to the amount of protein it contains. Cottonseed meal is one of the very richest feeds in protein and it is a very cheap source of this valuable food ingredient. In cattle feeding, cottonseed meal is used quite extensively and with the best results where certain precautions are followed. It has been used only to a limited extent in pig feeding, as fatal results have followed as a rule in the general way of feeding it. After feeding on it from four to six weeks the pigs would commence dying, and this has usually been the case when even very small amounts of the cottonseed meal have been fed along with other grain. The writer has found a mixture of 1-5 cottonseed meal and 4-5 corn or Kafir meal to give most excellent results when fed to pigs, and with very few exceptions no pigs have died, if the cottonseed meal was not continued longer than four weeks. Later experiments at this Station indicate that there are several conditions under which pigs may be fed a small amount of cottonseed meal with other grain for an indefinite time without injuring the pigs in any way, and good gains obtained with a small amount of grain. One of the conditions is where the shoats have access to plenty of range and green feed. Again, if the cottonseed meal is dropped after feeding three or four weeks and after a lapse of two or three weeks added to the feed again for three or four weeks, and dropped again for a few weeks, and so on until the pigs are grown or fattened, good gains will be obtained with practically no loss of pigs. Once in a great while there may be exceptions to both these methods as the following experiments will show. These experiments were planned with a view of ascertaining in what ways and under what conditions cottonseed meal may be fed safely to pigs.

## TRIAL I, SPRING 1900.

This experiment was planned to test the alternating method where the cottonseed meal was to be fed for a few weeks and then dropped for a few weeks and taken up again, and this process continued until the pigs were finished. This work, as are most of the following experiments, was rather preliminary work for future experiments.

Seventeen thrifty shoats varying more or less in size were used. They were mostly late fall pigs and averaged 80 pounds per head at the beginning of the experiment, March 22nd. They had the run of a large paddock where they could get a little green stuff now and then. For the first 27 days they were fed a grain mixture containing 1-5 cottonseed meal and 4-5 Kafir meal; for the next fourteen days nothing but Kafir meal was fed; for the next fourteen days 1-5 cottonseed meal was added, and then for seven days the cottonseed meal was dropped, and then for five days it was added. This made a total feeding period of sixty-seven days. At the close of this, part of the pigs were sold and the rest put in another experiment which included cottonseed meal as part of the feed. During forty-six days of the sixty-seven, the pigs had received a grain ration containing 1-5 cottonseed meal and none of them had died, and all had made very fair gains and on a moderate amount of grain.

For comparison, the first twenty-seven days in which 1-5 cottonseed meal was in the grain ration, are taken as period I; the twenty-one days in which no cottonseed meal was fed are taken as period II; and the other nineteen days in which 1-5 cottonseed meal was included are taken as period III.

The following are the results:

Period I. Feed; 1-5 cottonseed meal, 4-5 Kafir meal.

| | |
|---|---|
| Grain required to produce a pound of gain | 3.19 lbs. |
| Daily gain per pig | 1.28 lbs. |
| Cost per pound of gain | 1.72 cts. |

Period II. Feed; Kafir meal and corn meal.

| | |
|---|---|
| Grain required to produce a pound of gain | 5.71 lbs. |
| Daily gain per pig | 1.04 lbs. |
| Cost per pound of gain | 2.55 cts. |

Period III. Feed; 1-5 cottonseed meal, 4-5 Kafir meal and corn meal.

| | |
|---|---|
| Grain required to produce a pound of gain | 4.39 lbs. |
| Daily gain per pig | 1.21 lbs. |
| Cost per pound of gain | 2.37 cts. |

(Kafir meal 40 cts, per cwt. Cottonseed meal $1.10 per cwt.)

Close comparisons cannot be made between these periods as they vary in length and all the days are not consecutive. But it can be plainly seen that the pigs made much better gains while receiving the cottonseed meal and required much less grain to produce a pound of pork. None of the pigs died, although they had received cottonseed meal as a part of their ration for forty-six days, twenty-seven of which were consecutive days.

### TRIAL II, SPRING 1900.

This experiment was carried on with sixteen shoats. At the beginning of the experiment, April 12, they were the scrawniest, stunted pigs imaginable. Space will not be taken up to explain how this condition was produced. They were about one year old and averaged only 79 lbs. in weight. They were not only poor but small in size and had great large stomachs, caused by the feed they had received previous to this time.

For twenty-six days from April 12, these pigs were fed as follows:

They were hurdled on wheat and fed a light grain ration, consisting of 1-5 cottonseed meal and 4-5 Kafir meal. The following are the results for this period:

| | |
|---|---|
| Grain consumed | 1252 lbs. |
| Total gain | 402 lbs. |
| Grain eaten per pound of gain | 3.11 lbs. |
| Daily gain per pig | .96 lbs. |

These runts took to their feed and the new conditions readily and made rapid advancement from the start and showed no ill effects of the cottonseed meal. There is no question but that the wheat pasture was a great factor in bringing out these pigs.

At the end of the twenty-six days, May 8th, the sixteen pigs were taken off from the wheat and shut up in a lot and fed the same kind of grain, 1-5 cottonseed meal and 4-5 Kafir meal, for twenty-one days. They continued to flourish and at the end of the twenty-one days showed no ill effects of the cottonseed meal. The following are the results:

| | |
|---|---|
| Grain eaten | 1770 lbs. |
| Total gain | 576 lbs. |
| Grain eaten per pound of gain | 3.07 lbs. |
| Daily gain per pig | 1.71 lbs. |

All of the pigs were in very fair condition at the close of this period and five of the largest and best were sold. Here was a case where pigs were fed for forty-seven consecutive days on grain consisting of 1-5 cottonseed meal and 4-5 Kafir meal without killing any of the pigs, and all made good gains and on a small amount of grain. Further, the eleven pigs of this lot that were not sold were put in with other pigs where they had range and green feed and fed a grain ration of 1-5 cottonseed meal and 4-5 corn meal, until July 14th, when they were sold. None of these died and all made good gains. This was a case where pigs were fed part cottonseed meal for eighty-four consecutive days without killing the pigs, and good gains were obtained.

As was stated under trial I, at the close of that experiment, part of the pigs were sold and the balance continued on the ration containing cottonseed meal. Out of a feeding period of sixty-seven days these pigs had received a grain ration containing 1-5 cottonseed meal for forty-six days. This grain ration was continued without change until July 14th. Most of the time the pigs had access to pasture. With one exception the pigs continued to do well and were sold as fat hogs July 14th. The exception was a fine thrifty gilt. She had made most excellent gains. On June 18th, she died suddenly and on examination she showed the usual . condition that pigs do that have died from eating cottonseed meal. The internal organs are more or less inflamed and congested and the thorax cavity filled with a fluid. This gilt had received the cottonseed meal as a part of her ration twenty-six consecutive days prior to her death, and preceding this period for forty-one days, but not consecutive days.

## SUMMARY.

In these trials thirty-three pigs were fed on a grain ration consisting of 1-4 cottonseed meal and 4-5 corn or Kafir meal, for longer or shorter periods.

In one case, seventeen shoats were fed for sixty-seven days on forty-six of which the grain ration contained the cottonseed meal. These forty-six days were divided up into three periods, the longest one being twenty-seven days. All of the pigs lived and made good gains, and at the close of the sixty-seven days, part of the pigs were sold as fat hogs, and the remaining four were continued on the same grain ration. Twenty-one days from this time (after twenty-six consecutive days of cottonseed meal feeding) one of the four died from the effects of the cottonseed meal, as was clearly shown on examination. The one that died was a fine thrifty gilt. The remaining three pigs were continued on the same ration for twenty-six days longer, and then sold as fat hogs. This made forty-seven consecutive days of cottonseed meal feeding for these three, and prior to this time, in a period of sixty-seven days, they were fed on a ration containing 1-5 cottonseed meal for forty-six days, but not consecutive days.

In another case sixteen shoats were fed a ration containing 1-5 cottonseed meal for forty-seven consecutive days, and all lived and made good gains. At the end of this five were sold and the other eleven continued on the same grain ration for forty-seven consecutive days longer, and all the pigs lived and were sold as fat hogs at the end of this time. This made ninety-four consecutive days in which cottonseed meal was a part of the ration, and all the pigs lived and made good gains.

It should be borne in mind that in all these trials, the pigs had range and green feed most of the time. Other experiments with this problem have been completed at this station and others are under way. Some of these have been carried on to determine the comparative feeding value of a ration containing cottonseed meal and corn, with one of exclusive corn, and other mixtures. These and other results will be reported after completing further work.

Our work has gone far enough to enable us to state that excellent gains may be obtained by adding 1-5 cottonseed meal to a pig ration, and that it may be so fed that there is but a small chance of any of the pigs dying from the effects of it. We are not ready yet to say exactly how or under what conditions this should be, but under our methods the death rate was so small that the gain from feeding the cottonseed meal greatly over balanced it.

These directions might be followed by those who want to try feeding pigs on cottonseed meal:

Don't add more than 1-5 cottonseed meal to the ration.

Feed rather a light ration.

After feeding the ration containing the cottonseed meal for three weeks, drop the cottonseed meal for two or three weeks, then put it in for three weeks, then drop it for two or three weeks, and so on.

Endeavor to let the pigs have range and green feed at the same time.

Report results to the Experiment Station.

# COWPEA HAY FOR SWINE.

F. C. Burtis.

A series of experiments has been under way at this Station to ascertain the value of cowpea hay as a source of protein, and to give bulk to the ration, in pig feeding. The cured hay has been fed along with a ration of grain to certain lots of hogs in comparison with others fed exclusively on a grain ration.

The up-to-date hog raiser realizes the importance of furnishing sufficient bulk in the ration as well as the proper amount of protein. The pig is naturally an omnivorous feeder and if he is compelled to subsist exclusively on a grain ration of any of our common cereals, his health will suffer and he will not make a proper, nor the most profitable, development. It is true that most of our common farm crops do not contain enough protein for the best development of a pig, but this lack may be overcome by the addition of some feed that is rich in protein, and still the pigs will fail to make the most rapid development if the ration does not contain a certain amount of bulk that is necessary for healthy, vigorous digestive action. With the properly planned hog range, that contains along with the other green crops, some such a crop as cowpeas, alfalfa, or clover (green crops rich in protein), the problem is easily solved and very economically. But some seem to find it necessary to shut pigs in small pens and very often feed them nothing but corn or Kafir corn. With mature hogs that are to be fattened only a few weeks this will be all right, but with the growing shoats or breeding stock, if some feed is not added to furnish protein and bulk to the ration, the stock will do very poorly. Several feeds could be added to such a ration that would correct the evil and the question under consideration is to what extent would cowpea hay do this. The value of green clover, alfalfa and cowpeas as pig feed is pretty well known, but as yet little attention has been called to the value of these crops in the dry condition, hay, for pig feeding. Clover hay has been used for this purpose for a good many years by some, and in the experiments, pigs receiving clover hay with corn meal have made thirty per cent better gains than pigs receiving an exclusive cornmeal ration. Other experiments have demonstrated that pigs fed alfalfa hay along with corn or Kafir corn, make much better gains and require much less grain to produce a pound of gain than a pig fed on corn or Kafir corn only. Cowpea hay is about as rich in protein as alfalfa hay and is eaten by pigs confined in pens, and should give about the same results as clover or alfalfa hay.

To test the value of cowpea hay along this line, the following experiments were planned and carried out:

### TRIAL I.

This experiment was carried on during the winter of 1899-1900. The stock used was grade Poland-China, and were purchased for this experiment of a local hog buyer. They were not at all thrifty and were lean and lank. The bunch included gilts and barrows. They were probably about eight months old and averaged about 115 pounds at the beginning of the experiment. They were divided into two lots of four pigs each and were put in pens a couple of rods square, where they were kept during the experiment. Lot 2 was put on an exclusive grain ration, that consisted of 1-2 cornmeal and 1-2 Kafir meal. Lot 1 was fed from the same grain ration but was given all the cowpea hay they would eat in addition. The hay was fed just as it came from the stack, without any preparation, in a rack, in one side of the pens, so that the pigs could pick it over. A liberal amount, 8 to 10 pounds, was fed per day to the lot. From one-third to one-half of this was eaten up. The stems were eaten about as much as the leaves. The hay was of rather a poor quality but the pigs were always ready for it. Each lot was fed all the grain it could eat up clean. Wood ashes and salt were kept in the pens at all times.

The experiment began January 23rd, and closed April 3rd, making a period of ten weeks. The following are the results:

| | Lot I Lbs. | Lot II Lbs |
|---|---|---|
| Grain eaten per lot .................................. | 1,203 | 751. |
| Hay fed per lot .................................. | 589 | |
| Total gain per lot .................................. | 270 | 108 |
| Daily gain per pig .................................. | 1.09 | .43 |
| Grain eaten per lb. of gain .................................. | 4.46 | 6.95 |
| Cowpea hay fed per lb. of gain .................................. | 2.18 | |

At the close of the experiment Lot I was in a fair marketable condition but Lot II was not in as good condition.

The better appetite of Lot I was very noticeable all through the experiment. Lot I, the one that received the cowpea hay, made 150 per cent better gain than Lot II, and required two and one-half pounds less of grain to produce each pound of pork than Lot II did. While the pigs fed cowpea hay with their grain made a very favorable showing over those fed only on grain, the results were not as would justify shutting the pigs up in pens to be fed in that way if good wheat pasture was available. In studying these results the fact must be kept in mind that these shoats were fairly well grown at the beginning of the experiment, but were not in a thrifty condition.

### TRIAL II.

This experiment was carried on during the winter of 1900-1901. The stock used was twelve grade Poland China pigs, raised on the Station farm. They were late fall pigs and in a good thrifty condition at the beginning of the experiment, at which time they averaged 61 lbs.

They were divided into two lots of six pigs each and put in the pens that were used in the previous experiment. The treatment was practically the same as in the previous experiment. Lot I was fed grain and cowpea hay, Lot II grain only. As before, the grain consisted of 1-2 cornmeal and 1-2 Kafir meal. Each lot was fed all the grain it would clean up. The cowpea hay was fed as before. The quality was very fair and about half the amount fed, 7 to 10 pounds, was eaten. Both lots were kept well supplied with water, charcoal, wood ashes and salt.

The experiment extended over a period of ten weeks, December 12th to March 1st. The following are the results:

| | Lot I Lbs. | Lot II Lbs |
|---|---|---|
| Grain eaten per lot | 1,372 | 1,174. |
| Cowpea hay eaten per lot | 359 | |
| Total gain per lot | 191 | 119. |
| Daily gain per pig | .46 | .24 |
| Grain eaten per pound of gain | 7.1 | 9.8 |
| Cowpea hay eaten per pound of gain | 1.87 | |

For the first few weeks both lots ate practically the same amount of grain, but gradually Lot II fell behind and was still losing ground at the close of the experiment. From the start neither lot seemed to be satisfied and did not do real well, but Lot I, was more contented than Lot II and generally made better gain. The cowpea hay was always eaten with a relish. At the close of the experiment neither lot was making any gain to speak of but Lot I was doing a little the better. It was evident that a change of condition was necessary to finish the pigs with profit. In judging the results the fact should be kept in mind that the pigs were quite young and kept under confinement. Lot I, which was fed the cowpea hay made sixty per cent better gains than the lot not fed cowpea hay and required 2.7 pounds less grain to produce each pound of pork.

## SUMMARY.

The first experiment would indicate that shoats about eight months old could be put in pens and fattened on corn and Kafir corn with the addition of cowpea hay, in a fairly profitable manner and with much better success than pigs under like conditions without the cowpea hay. But the results would not justify abandoning a good range and plenty of green feed.

The second experiment furnishes further evidence that it is not profitable to shut up four-months-old pigs in small pens to fatten them, especially when they are to be fed nothing but corn or Kafir corn. But if they must be fed under such conditions a little good cowpea hay in addition to the grain will help matters very much.

# THE ORCHARD.

O. M. Morris.

## LOCATION.

The orchard and fruit plantation should be located on sloping land. The soil will be drained of surplus water and will not bake and become as dry and hard in time of drouth. The north and east slopes are the best. They are much cooler in summer and are not subject to as great variations of temperature in winter. The effect of the afternoon sun is somewhat weakened by the slope and the early blooming trees are not forced into bloom so early and more frequently escape the late frosts.

The protection from the wind is perhaps the greatest benefit derived from such slopes. The warm dry winds of July and August do not strike the orchard with their full force and thus a great amount of moisture is saved for the use of the trees and fruit. This protection from the wind is also of great value to young trees while they are forming their root system and becoming well established.

The southern slopes are warmer and earlier in the spring and for some purposes are to be preferred, but usually the fruit matures early enough and with apples in particular the latest varieties mature almost too early for winter use.

A sandy loam soil with clay subsoil is best adapted to the use of all kinds of fruits. The trees set on heavy clay soil will produce a heavy growth of foliage and wood but will be slow to come into bearing, and the fruit will not be as bright in color as that grown on sandy soil. The trees grown on a poor sandy soil will usually make a poor growth and begin bearing young. These trees will be short-lived and weak. The poor, thin, gray and black soils are poorly adapted to trees. The trees set on such land are almost sure to make a very poor growth and be shy bearers. Good upland is the best for orchard land. The bottom land will grow better and stronger trees but they will seldom be as productive. This is especially true of the peach, plum and apricot. The late frosts are more liable to destroy the crop while the trees are in blossom on low land. The lowland also maintains better conditions for the plant diseases that are sure to infest the orchards sooner or later. If the land was formerly in timber, it should be carefully examined for evidences of root-rot before setting out fruit trees.

## PREPARATION OF THE LAND.

The land should be cultivated for two or three years and freed of all wild sod and weeds before it is set to orchard. The land should be plowed deep so as to give as deep soil as possible. Most of the prairie soil in Oklahoma is very poor in humus or decaying vegetable matter. Such lands should be well manured before the orchard is set. The manure should be scattered evenly over the field and turned under with the turning plow. The practice of applying large quantities of manure in places where the tree is to stand can not be recommended. This practice of uneven manuring is usually carried out in one of two ways. The manure is applied very thickly in the immediate vicinity of the tree and worked into the soil or it is thrown in dead furrows that are made in the row where the trees are to be set, and then covered. The manure will decay faster if evenly distributed over the land. The trees will gather food from all directions and form a better root system. Where the fertilizer is unevenly distributed, the roots seek the most fertile soil and are developed there in greatest numbers. As a result the water is taken out of such places very fast and in dry weather these spots dry out and the greater part of the root system is left without water. Trees set on such land will always suffer more for water than on soil evenly fertilized.

Subsoiling is beneficial on soil that has a hard clay subsoil. Throwing out a deep dead furrow where the row of trees is to stand and then filling again after the trees are set is often of value both to loosen the subsoil and to help drain the land. These furrows should run up and down hill and be as deep as is possible to make them with the tools at hand. The water that stands on the ground seldom does any harm to the trees but the soil becomes packed and in a little dry spell bakes and dries out very rapidly. A short time before the trees are set the land should be stirred deep and the soil well pulverized and left in a smooth, level condition free from dead furrows and ridges.

## CULTIVATION.

The cultivation of the orchard should begin as soon as the trees are set and continue throughout the life of the orchard. The first work should be done with the turning plow early in the spring before the trees start to grow. The soil should be stirred deep and well pulverized. All manure and trash that is on the surface should be turned under and covered well so that it will decay rapidly. The plow should run as close to the trees as possible without barking the trees or limbs with the harness. A little pruning of the shallow roots will not harm the tree and will often be a benefit to it by helping to form a deep root system. It is best to use a small plow, not larger than 12 inches, for this work. The furrows and ridges left will be smaller and can be reduced and leveled over with less trouble. The land should be harrowed and smoothed down as soon as plowed. This deep plowing and working the soil serves several important purposes.

Plowing and stirring the soil fines it and increases the depth thus giving a greater feeding surface, foraging, and root-hold area to the plants. The soil requires thorough pulverizing and mixing that it may give the best condition for root growth. There is but very little vegetable matter in the average soil in Oklahoma and the soil when plowed simply breaks into small clods that are hard and compact and almost impenetrable to root growth. These clods yield very little food to the plants, although they usually contain an abundance. When these clods are broken up and pulverized so that the air and moisture in the soil can act upon them the plant food is made available to the plants and used by them.

One of the most important benefits derived from deep plowing is the increasing of the water-holding capacity of the soil. The water that is held in the soil consists of a thin film of water surrounding each particle of soil. The finer the soil the more water it will hold. The deep plowing will furnish a deep bed for the water. The annual rainfall is great enough to supply the wants of all our orchard fruits but it is so distributed that during the spring and fall there is an oversupply of water and during the summer there is not enough to supply the demands of the trees. All the methods of tillage that will help to retain the moisture in the soil should be used if possible.

The spring and summer cultivation should keep the surface level and well pulverized. No weeds or grass should be allowed to grow in the orchard. The weeds and grass are sometimes let grow in the vain hope of shading the ground and thus saving the moisture. The result of such a method is that the moisture is taken out of the soil by the weeds much faster than it would be by the sun. Shallow level cultivation forms an earth mulch and is the best method of conserving the soil moisture. The orchard should be cultivated after each rain to break the crust and prevent the soil from baking. This cultivation should begin early in the spring and continue until late in the summer.

The deep plowing in early spring and shallow cultivation during the summer are of great value in reducing the soil temperature during the hottest part of the summer. The deep bed of soil and shallow mulch act as a dead air space and prevent the heat penetrating deep into the soil. This benefit of cultivation is most apparent on large trees that are in bearing. The foliage retains a deep green color until fall and the fruit is full size and well matured. The trees can not grow and mature fruit when the roots are in dry, hot soil.

The method of cultivation described in the foregoing paragraph should be put into operation as soon as the orchard is set and followed from year to year. After the trees become large and cover most of the ground the deep plowing may be dispensed with, and the soil worked up in the spring with some form of disk or spading harrow. The shallow, surface cultivation must be continued as long as profitable returns are expected from the orchard. The practice of seeding down the old orchard cannot be expected to give good results in Oklahoma, unless the orchard happens to be in some very much favored location. The long summers with light rainfall will probably always be the main obstacle in the way of such treatment.

### TOOLS USED IN ORCHARD CULTIVATION.

The ordinary two horse plow is the best implement to use in early spring. This will stir the soil to a good depth and put it in such condition that the rain will sink down and not run off the land. It also leaves the surface open and free from trash and litter that would be in the way of the cultivator. The plow can be run as close to the tree as the team can be driven without danger of barking the tree or limbs with the harness. If the plow passes too close to the tree it should be turned out of the ground or raised so as to run very shallow. A small plow six or eight inches wide is very good to finish around the trees and along the dead furrows but it is not necessary. Some form of a plow is necessary and the orchard can not be well cared for without it.

The shallow summer cultivation can be done with several different kinds of tools. The small shovel cultivator is a very good tool and can be used for a great many purposes. The one horse five shovel cultivator is one of the best tools for a small place. It can be adjusted to do almost any kind of work, and to work in narrow spaces. It destroys the weeds, breaks up the surface soil and leaves it level. There are several kinds of disk harrows and cut-away harrows that do good work and leave the soil in an almost ideal condition. The disk harrow is one of the best tools for summer cultivation of the orchard. It destroys the weeds and leaves the soil level and well pulverized, thus forming a good mulch. The cutaway harrows are good for surface cultivation but do not as a rule work well if there is much trash or weeds and grass on the ground. The common straight and slant-toothed harrow is of great value in smoothing down the surface of the soil after the plow and heavy cultvators. It is also of value to break the crust of the soil after a rain. There are several kinds of spring toothed harrows that do good work and are valuable as surface cultivators. The roller and drag are of but little value in orchard cultivation. The roller can be used to advantage sometimes on very loose, gravelly soils.

### CROPPING THE ORCHARD.

The orchard should be given clean cultivation from the start. The trees should not be compelled to share the fertility and moisture of the land with other crops. If this method is followed from the start it will be much easier to keep the land free from weeds and to give the trees better care. They will reduce the labor of caring for the orchard to the minimum. Some kinds of crops can be grown in young orchards without doing much harm to the trees. The hoed or cultivated crops are all that should be planted between the trees and then the trees should have plenty of room. Early potatoes and such early maturing crops are best to be used for such purposes.

The cultivation should be primarily for the orchard and not for the crop. The moisture should be saved for the trees as much as possible. The sowed crops, such as wheat and oats should never be grown in the orchard on account of preventing cultivation at the time it is most needed. The growing of all kinds of harvest crops should be discontinued under all conditions and circumstances after the orchard is four or five years old. The trees draw moisture from a much larger circle of ground than that covered by the top and by the time the orchard is five years old all the soil space will be drawn on for moisture.

### COVER CROPS.

Cover crops are crops grown on the land during the late summer, fall and winter and left on the ground for the purpose of covering the soil during winter and thus preventing its blowing, to catch and hold the rain and snow, to form a mulch, and to add vegetable matter to the soil. In young orchards the cover crops are often of great value, but in the older orchards their value is often questionable.

The value of a cover crop depends much upon the kind of crop and the time it is sown. Cowpeas and plants of that class are valuable fertilizing plants and form a good cover for the winter. The greatest objection to this crop is that it must be sown early in the summer so that it can make its growth before frost in the fall. This places the crop on the land during the most of the dry weather when all of the moisture is needed by the trees. The bad effect of this will be noticed most on bearing trees by the fruit falling before maturing. Wheat and rye can be sown much later and will make a good cover for the winter and furnish a good supply of manure to be turned under in the spring. These crops will remove soil moisture during the fall and winter and would not be harmful to the trees. The peach tree might suffer loss of fruit buds if the ground becomes too dry during cold weather, but most of the orchard fruits usually pass the winter without suffering much for water.

The cover crop will, if properly handled, improve the physical condition of the soil and increase its water-holding capacity but there may be a doubt as to whether it will do this to sufficient extent to furnish the extra amount of water used by the growing crop. On June 20, 1899 a plat in the Station apple orchard was sown to cowpeas. The peas grew and made a good mulch which laid on the ground all winter and was turned under in March, 1900. July 16, 1900, the same plat was sown to cowpeas as before. They made a better mulch than the previous crop and were treated in the same way. During the summer of 1899 the trees that were surrounded with cowpeas showed by comparing with trees of an adjoining plat that was given clean cultivation, that the cowpeas were robbing them of moisture. During the summer of 1900, however, no difference could be seen in the condition of the trees in the two plats. In January, 1901, the measurements of all the trees were taken and compared with measurements taken in January, 1899. There was no appreciable difference in the growth made by the two plats of trees. These plats have not been under treatment long enough to furnish definite results, but it seems to indicate that this method of growing cover crops may be beneficial on poor land.

### MANURING THE ORCHARD.

The soil in most parts of Oklahoma contains a sufficient supply or plant food to produce large thrifty trees and good crops of fruit. The addition of decaying vegetable matter to the soil is the best thing that can be done in most cases. This material should be applied in the form of manure and green crops as much as possible. The plant food contained in the manure and green crops is valuable when placed in the soil but the improvement in the condition of the soil is often of even greater importance. The soil becomes more mellow and porous and is capable of holding much more water. The air can pass through the soil much better and carry on the work of decay much faster. The application of commercial fertilizer is not necessary in most cases and would not pay for the material used. Concentrated fertilizers should be used only on land that is in good physical condition and well cultivated. It may be used on other land but it cannot yield its best returns on such land. Barnyard manure is the best fertilizer for most farms and for most crops. The use of lime and wood ashes is to be commended if the land contains a large amount of humus and is free from alkali. Alkali lands can be improved by thorough drainage and the application of large quantities of manure.

## CHOICE OF VARIETIES.

The subject of choice of varieties is the one upon which most questions are asked and the one upon which the least satisfactory advice can be given. The choice of varieties brings in so many personal likes and dislikes that in the end the orchardist must and does choose his own varieties. The orchardist should first study his soil, his location and surroundings. This will enable him to tell what class of trees and fruit will be best suited to his location. With this information in hand he is able to select the varieties that suit him.

Do not covet a variety simply because it was a favorite in an old orchard in another state, but take those that are doing well in your own locality. It is probable that many of the trees claimed to be untrue to name are what they were sold for. The orchardist formerly knew them with different condition of climate and expects them to be here just like those he used to know. There has been an enormous amount of poor trees that were untrue to name sold in the territory and many are still being sold. The reliable nurseries are fast driving out these irresponsible tree dealers and should have the entire support of all fruit tree buyers.

The following varieties of fruit have been planted by fruit growers in different parts of the territory and in most cases are giving satisfaction. The varieties are arranged in order of their preference by the fruit growers.

### APPLES.

1. Missouri Pippin,
2. Ben Davis,
3. Winesap,
4. Jonathan,
5. Arkansas Black,
6. Maiden's Blush,
7. Mammoth Black Twig,
8. Cooper's Early White,
9. Yellow Transparent,
10. Gano,
11. Red Astrachan,
12. Lowell.
13. Rome Beauty,
14. Janet,
15. Oldenberg,
16. Early Harvest.
17. Grime's Golden Pippin,
18. Sweet June,
19. Red June,
20. Wolf River,
21. Striped Red June,
22. York Imperial,
23. Summer Queen,
24. Romanite,
25. Sops of Wine,
26. Shockley,
27. Benoni,
28. Shannon Pippin,
29. Buckingham.

### PEARS

1. Kieffer,
2. Bartlett,
3. Duchess,
4. LeConte,
5. Garber,
6. Seckel,
7. Sheldon,

### PEACHES.

1. Elberta,
2. Alexander,
3. Champion,
4. Crawford's Late,
5. Crawford's Early,
6. Heath Cling,
7. Salway,
8. Amsden,
9. Chinese Cling,
10. Gen. Lee.
11. Mamie Ross.
12. Sneed,
13. Arkansas Traveler,
14. Early Rivers,
15. Triumph,
16. Hale,
17. Oldmixon Cling,
18. Oldmixon Free.
19. Indian,
20. Picquet Late,
21. Bell's October,
22. Crosby,
23. Stump,
24. Globe,
25. Wonderful.
26. Snow,
27. Family Favorite,
28. Foster,
29. Carman.

### PLUMS.

1. Wild Goose,
2. Abundance,
3. Burbank, .
4. Wickson,
5. Marianna,
6. Damson,
7. Botan,
8. Golden Beauty,
9. Arkansas Lombard,
10. German Prune,
11. Weaver,
12. Green Gage,
13. Quaker,
14. Wilmeth,
15. Satsuma,
16. Shipper's Pride.
17. Miner,
18. Normand,
19. Ohio Prolific.

### CHERRIES.

1. Early Richmond,
2. English Morello
3. Montmorency,
4. Mayduke,
5. Dyehouse,
6. Gov. Wood,
7. Ostheim,
8. Olivet,

### APRICOTS.

Observations made in different parts of the territory seem to indicate that a full crop will be very rarely obtained. The trees make a good growth and set an abundance of fruit-buds which are usually killed in the winter or by late freezes in the spring. The blossoming period may be delayed from two to four days by keeping the branches of the trees well coated with whitewash from December until the flowers open. This method will not however, be found very efficient. Last spring, two weeks after the flowers were open, there was enough frost to kill most of the crop under ordinary conditions. Laying down as with blackberries has been tried but it is only partially successful. The orchardist must depend on selecting such varieties as will best survive the frosts and plant them in such positions that they will be protected from the heat of the sun. The Jackson and Golden Russian seem to stand the late frosts better than other varieties in the Station orchard. Although neither of these have borne half of a crop, they have ripened a few fruits each year for the last six years. The following are the varieties which were planted by the Station:

1. Alexander,
2. Budd,
3. Early Golden,
4. Gibb,
5. Golden Russian,
6. Jackson,
7. Luizet,
8. New Castle,
9. Oldberg.
10. Peach,
11. Shemsi.

### BUYING THE TREES.

It is the best plan to buy the trees in the fall of some nearby nursery that the buyer can visit and buy the trees on the ground. This will save the expense of freight and enable the buyer to get the trees home in first class condition. Trees transported long distances will usually live and do quite as well as locally grown trees if they are properly packed for shipment and are delivered in good condition. If trees of the desired variety cannot be obtained of reliable nurserymen it is often a good plan to buy good thrifty stock of some other variety and then the following year bud or graft the top ones of the desired variety.

The buyer should not always take the cheapest trees. A good tree is worth more than a poor one and the difference in their value will grow greater as the trees grow older. Good trees are the best and cheapest for all purposes and should always be used if they can be secured. Exorbitant prices do not insure good trees and should not be paid. The variety of fruit that is claimed to be entirely new and the equal of which has never been known, is out of place on the average farm. A strange characteristic of such varieties is that they always originate in some other part of the country and there is no orchard near in which this variety is in bearing to prove its merits.

The buyer should take only trees that are thrifty, well grown, and free from blemishes and indications of insects and diseases. The tree should present the charactertistics of the variety to which it belongs. They should be well branched, wood firm, and buds well developed. The budded and grafted trees each have their strong points and nature of the variety, the location, and the desires of the grower must decide which to take. The peach, plum, cherry, and apricot are almost always budded. The apple and pear are usually grafted, although budding on these is quite common in the east and is being used more each year in the west. Practically there is but little difference between the whole-root grafted tree and a budded tree.

The whole-root and piece-root grafts each have some advantages over the other, and the climate, and variety of the tree should determine which should be used. The whole-root graft requires one seedling for each graft. The piece-root one seedling for every two or three grafts. These are facts that interest the nurseryman more than the fruit grower. The whole-root trees will grow much faster for the first three or four years and will form a better and more evenly distributed root system than the piece-root graft . It will be better braced and will stand much better when exposed to hard winds than the piece-root grafts. The whole-root graft has a root system already developed for it to begin growth upon. The piece-root graft is reduced almost to a cutting and must grow as such. If the cion of the piece-root graft is made long and set deep in the ground it will often strike roots and soon be up on its own root. This is a great advantage in very cold climates or where the roots winter-kill badly.

## SETTING THE TREES.

Fruit trees should be set in November or December in this latitude, and may be set in March. They are frequently set too close together for them to attain their full size and productiveness. Trees are wide feeders and should be set far enough apart to develop their natural form and size without being crowded by neighboring trees. There should be space enough between the trees after they are full-grown to admit of the regular operation of cultivation and spraying. These operations must continue as long as the orchard lasts and room must be left for the work to be well done. The distance at which trees should be set will depend much upon the method of pruning followed. If the trees are headed in vigorously and systematically they may be set one-fourth or one-third closer than if allowed to grow to their natural size. Heading in should always be practiced with dwarf pears and many of our best orchardists head in their peaches, plums and quinces. Thin planting is the safer rule for the majority of cases. The following distances are about the best on the average land in Oklahoma when the trees are allowed to grow to their full size:

Apples 30 to 35 feet each way.
Pears, standard, 20 to 25 feet.
Pears, dwarf, 12 to 16 feet.
Peaches and nectarines 20 to 24 feet.
Plums and apricots 20 feet.
Cherries 20 to 25 feet.
Quinces 16 feet.

Short-lived or early bearing trees are often planted between apple trees. This is sometimes practiced with good results but usually it is a bad practice and results in permanent harm to the orchard. While the orchard is young there is some unoccupied land that may be planted to some hoed crop but this land is all needed by the apple trees by the time earlier bearing trees become productive. There is not one man in a dozen who will cut out the trees that are bearing fruit before they have done permanent harm to the apple trees. This applies as well to planting blackberries and the like between orchard trees of any kind. The roots of trees spread over a much larger area than the top and the roots will be over-lapping and robbing the slower-growing trees long before there seems to be any danger of crowding. The thickly planted orchards will be more difficult to cultivate and keep in good condition.

There are many methods of laying off the land in preparation to setting the trees. A simple method is to lay off the rows in both directions with a lister or stirring plow. The trees can then be placed at the intersection of the two furrows and placed in line with but little work. The plow can be run deep enough so that only a little soil will have to be moved in order to place the tree. If the top soil is shallow and underlaid with a hard clay subsoil the hole for the tree should be made much larger and filled with surface soil.

The trees should be set at the same depth or a little deeper than they stood in the nursery row. If set too shallow the crown and roots are exposed to the dry soil and air and the tree is almost sure to perish. If set too deep the roots will be in cold earth and will not start into growth until long after the buds have started. This causes the tree to start growth in the early spring and then die as soon as dry weather sets in.

The soil should be firmed well around the roots and base of the tree to keep the roots from drying and hold the tree firmly in position. It is a good plan to lean the tree a little toward the direction of the prevailing wind. The tree should not lean more than two inches to the foot from a perpendicular line. If it leans too much it will make a very badly shaped head.

## WRAPPING THE TREES.

The rabbits damage and kill a great many young trees during the winter by peeling the bark from the trunk and lower limbs. There are several methods of protecting the trees, the most common of which is to wrap the tree with corn stalks, hay, or heavy paper. Wire netting is sometimes used but it is too expensive for most such work. The aim is to wrap the tree so that rabbits cannot reach the bark. This method of wrapping trees proves very effective and is well worth the doing. Some of these protectors if properly fastened, may be left on all summer to shield the tree from the hot sun. The binding must not be tight or it will choke the tree, but simply close enough to hold the covering in place. The wrapping of corn stalks or similar material is the best if it is left on all summer. The stalks are cut diagonally and stuck into the ground as close to each other as they can be set. The top is held in place by wrapping with a wire or heavy twine. This does not form a good breeding place for the borers as is commonly supposed. There can almost always be some bugs found hiding in such places but they are usually harmless. The borers are always worse in trees that suffer from sunscald and drouth and seldom bother well-protected and fast growing trees.

## WASHING TREES.

Washing trees with soft soap or blood to protect from rabbits is often quite effectual. Washing with blood is not practicable in large orchards but can easily be done two or three times each winter on the average farm. This operation depends on making the bark distasteful to the rabbits so that they will not bother the trees. This method is cheap and in many cases has proven entirely satisfactory.

The practice of washing the trees with some kind of strong solution during the spring and summer is looked upon by many as one of the necessary operations in good care of the orchard. The object of this wash is to keep the trunk of the tree free from insects and diseases. It may be a benefit to the tree by softening the dry, hard bark on stunted and bark-bound trees. Most washes are used for the purpose of protecting the tree from the attacks of borers and for such purpose the value of many washes is doubtful. Soft soap is one of the best washes for young trees. It is cheap, easily made, and can be made by any one. One pound of concentrated lye dissolved in two gallons of water is also a very good wash. Neither of these washes will entirely prevent borers and should be used only as one of the operations of cultivation and care necessary to keep the trees in a healthy growing condition.

### PRUNING THE TREES.

Apple trees require pruning from the time they are set in the orchard until they cease to be of value as orchard trees. The roots necessarily receive severe pruning when the trees are lifted from the nursery row; the larger portion of the roots remaining in the ground. The roots that are broken and mashed should be removed and the ends of all roots cut clean and smooth up to sound bark. This will put them in much better condition to heal over quickly. It is best to leave as much of the roots on the tree as possible and not to prune them any more than is necessary to put them in good condition. The top should be cut back severely to balance the relation between the leaf surface and the roots. The limbs can be cut back, leaving only four to ten inches of each limb. If there are more limbs than are wanted to form the main frame work of the top, the extra limbs should be cut out entirely.

There should not be more than five or six main limbs. The top can branch from these and be formed better and with less danger of interfering branches. The first two years after the trees are set in the orchard is the time to form the frame work of the top and if the tree is cared for and pruned properly during this time, the future pruning will be light and easily done. It will consist of removing interfering twigs and thinning the top to admit air and sunlight.

The head of the tree should be formed low, the lower limbs about two feet from the ground. The low headed trees shade the trunk and surrounding soil very early in the life of the tree and in this way form a great protection against sunscald. The low headed trees are not so badly beaten and shaken by the wind. This point is perhaps of greater value than that of protecting from sunscald. This is equally true of all kinds of orchard trees.

Pear trees should be pruned the same as apple trees for the first five or six years. After the tree comes into bearing the top must be cut back each year. This is especially true of dwarf pears where heavy pruning is one of the conditions that help to keep the tree dwarf. The fruit buds are formed on the end of twigs or spurs and it seldom happens that a twig bears fruit and develops a fruit bud the same year. Cutting back the top during the winter will cause the tree to develop a large number of fruit buds each year.

Peaches and apricot trees should be set when one or two years old from the bud. When the trees are set, the roots are pruned no more than is necessary to put them in good condition and the top is pruned to almost a straight stock. The side branches are cut back to two or three buds and the central stem is cut back to not more than two or three feet in length. The frame work of the tree should be formed about the same as that of the apple tree. The trees should be pruned each year to obtain the best fruit. The trees nearly always set more fruit than they can mature and unless the fruit is thinned it will be small and of poor quality. The trees should be headed in during the winter each year. This heading in consists of cutting back the longest and strongest branches and usually aims to remove about one-half of last year's wood. This serves the purpose of thinning the fruit and keeping the tree within bounds.

Plum trees should be cut back about the same as peach trees when set. The subsequent pruning is more like that given the apple. The trees require only a little pruning to keep the top open to admit light and air. The branches may be cut back the same as peach trees and it will answer the same purpose with the American varieties only to a less extent. The Japan varieties bear their fruit in spurs and for that reason should be pruned the same as apple trees.

Cherry trees should be pruned for setting about the same as the peach. The care given all trees in forming the head is applicable to the cherry. After the frame work for the head is started right the trees will require little pruning beyond that necessary to remove interfering branches.

### SPRAYING.

Spraying if properly done will prevent the attacks of most plant diseases but will cure plants of very few diseases after the disease has gained a foothold on the plant. To spray for each and every plant disease would be an almost endless task. Fortunately about ninety per cent of all the diseases that can be prevented by spraying require about the same treatment. Four good sprayings a year will keep most orchards free from disease. The first application should be given before the buds start in the spring; the second as soon as the flowers have dropped; the third about two weeks after the second, and the fourth two or three weeks later. The following solution is the one in most common use and seems as well adapted for all special cases as for general use. The copper compound is the active part against diseases and the Paris green against eating insects:

Bordeaux mixture and Paris green.
Copper sulfate (blue vitriol) 4 pounds.
Quicklime (not air slacked) 4 pounds.
Water, to make 50 gallons.

Dissolve the copper sulfate in about two gallons of hot water, contained in a wooden vessel, by stirring, or even better, by suspending the sulfate contained in a cheese cloth sack, in a large bucketful of cold water. With the cold water and cheese cloth bag, a longer time is required. Pour the sulfate solution in the barrel or tank used for spraying, and fill one-third to one-half full of water. Slake the lime by addition of a small quantity of water, and when slacked cover freely with water and stir. Pour the milk of lime thus made into the copper sulfate, straining it through a brass wire strainer of about 30 meshes to the inch. Pour more water over the remaining lime, stir and pour into the other; repeat this operation until all the lime, but stone lumps or sand is shaken up in the milk of lime. Now add water to make 50 gallons in the tank, and add four ounces of Paris green or London purple. After thorough agitation, the mixture is ready to apply. The mixture must be made fresh before using and any left over for a time, should be thrown out or fresh lime added.

Insects that have sucking mouth-parts cannot be killed with Paris green or London purple and should be sprayed with kerosene emulsion which kills by contact.

### KEROSENE EMULSION.

Dissolve one-half pound hard soap in one gallon of water (preferably soft water) and while still hot remove from the fire and add two gallons of kerosene. When soft soap is used, take equal quantities of soap and oil and omit the water before mixing. Stir the mixture violently by driving it through a force pump back into the vessel, until it becomes a creamy mass that will not separate. This requires usually from five to ten minutes. The emulsion is then ready to be diluted with water and applied. For the common scale insects and hard bodied insects, like chinch bugs use 1 part emulsion to 8 or 10 parts water. For soft bodied insects (plant lice, etc.) use 1 part emulsion to 15 or 20 parts water.

Spraying is not a fad but as necessary an operation in successful fruit growing as cultivation or pruning.

### WIND-BREAKS.

Wind-breaks should be provided for the orchard and berry patches. The south and west sides should be protected by planting of trees near the edge of the orchard. The south and southwest winds have the greatest effect upon the trees and are about the only winds that do much harm to the orchard. There is time and labor connected with the planting and care of the wind-break but they are well worth their cost.

A wind-break reduces the evaporation of water from the surface of the soil thus tending to mitigate drought in summer and root-injury in winter. The value of the wind-break for this purpose can hardly be overestimated. Enormous quantities of water are carried away from the land by the dry south winds and anything that will check their force will conserve the moisture to a great extent.

Wind-breaks lessen the amount of wind-fall fruit. It is the hard gales that shake so many immature fruits from the trees. A wind-break lessens the breaking of trees loaded with fruit. It also enables the trees to grow straighter. These are not all of the benefits to be derived from windbreaks although they are the most important ones.

The following are the most common injuries resulting from a wind-break.

Fruit immediately adjoining the wind-break is apt to be much injured by insects and diseases and to be small and inferior in color. Trees immediately adjoining the wind-break are often less thrifty than others. A few other injuries are sometimes charged up to the wind-break but they are not very important. The first injuries just mentioned can be met and overcome by a little work with the spray pump, which must be performed whether there is a wind-break near by or not. The second class of injuries is caused by the wind-break being placed too near the plantation and is not a fault of the plantation in itself.

The best form of wind-break is perhaps formed by setting trees four or five feet apart in rows that are about five feet apart. There should be a space of thirty feet, and forty feet would be better, between the orchard and the wind-break. Some kind of fast growing trees should be used. The elm, soft maple, catalpa, and mulberry are good trees for this purpose. The best results will be obtained if the wind-break can be set two or three years before the orchard. The wind-break if properly cared for will also furnish a constant supply of posts and fire wood. Black locusts grow rapidly and make a good wind-break as well as furnish excellent posts. There is, however, some possibility of their being attacked by borers, as in Kansas, though up to this time, no trouble from this source has been experienced.

# Reprints From the Eleventh Annual Report.

## 1901-1902.

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## SUMMARY OF PRESS BULLETINS.

### PASTURING WHEAT.

While it is not possible to accurately forecast the outcome of the wheat crop, reasonable prudence would suggest that for the present, wheat should not be pastured to any great extent. The conditions have been such during the summer and fall just past that much wheat was sown in soil that had been poorly prepared, and even with the best of preparation, there has not been sufficient moisture for vigorous growth. There were heavy rains during the fall of 1900 and the soil was filled with moisture and thoroughly saturated. With these conditions and favorable winter weather, wheat furnished an unusual amount of pasture last winter and was in some cases actually benefited by pasturing. The conditions are entirely different at present. In general, the fall rains have been sufficient only to moisten the soil to a depth of about six inches while the subsoil has scarcely been reached by the water. The wheat is thus dependent upon the rains that come during the winter and while it is possible that there may be plenty of rain for the purpose, the average rainfall of past seasons has been insufficient. It is true that feed is scarce and high in price and the wheat pasture sells for good prices. Some prefer to take what is to be had in the way of pasture from the wheat crop and to plant some other crop if the wheat is harmed by pasturing, fearing that possibly wheat may not yield well next harvest even if not pastured. Looked at in this light, pasturing wheat is profitable even though it kills the wheat. But it will not do to follow the practice of last winter when it was scarcely possible to pasture wheat too heavily in Oklahoma. (December, 1901).

### SELECTION OF COTTONSEED.

At ginning time in Oklahoma last year, cottonseed brought good prices at the oil mills and the greater part of it was marketed at that time. The result was a heavy demand for seed and a short supply last spring. There was seed enough, however, of one sort and another to plant a large acreage, and the tendency will be to sell seed close again this fall.

Many questions are asked about varieties. The best answer to all of them is the remark of a southern cotton grower who said. "I can take any of the so-called distinct varieties of cotton and in a few years develop all the known varieties from it. In other words, they will develop themselves in the course of time. All that is necessary is to watch the field from year to year and when a 'sport' is noticed save the seeds and plant them by themselves."

There is abundant evidence of the fact that cotton varieties become modified and become adapted to the conditions under which they are grown. There is thus every reason to believe that proper selection will develop a type or types of cotton particularly adapted to Oklahoma. In fact, it is probable that this type already exists on the few farms where intelligent selection of cottonseed is practiced.

There are three general ways by which new varieties are originated and by which the excellence of any variety is perpetuated. These are (1) saving seed from early maturing bolls, (2) selecting seed from plants of individual excellence, and (3) cross fertilization.

The first of these methods may be carried out without difficulty on every Oklahoma farm where cotton is grown. The first few loads of seed cotton are usually picked by the farmer himself, and he is thus enabled to know to a great extent the character of the lint. If these first pickings are ginned and the seed saved and taken home as seed for next year's crop, a long step has been taken toward the fixing of any desirable characteristics that the particular variety or mixture of varieties may possess.

The selection of seed from plants of individual excellence requires more care, patience and labor than the plan just described It is not probable, neither is it necessary, that many cotton growers will go to the trouble and expense of carrying out this plan, yet there are substantial returns in store for a few who will do the work well.

Still fewer will attempt cross fertilization and there is less need of it. The improvement of the grade of our cotton can be steadily pushed forward by every cotton grower exercising care in seed selection from the present stock and when this comes to be the general practice, a sufficient number of specialists will appear to more than supply the demand for new varieties. (September, 1901).

## BROOM CORN.

Broom corn is a variety of sorghum and has many of the qualities of ordinary sorghum. Like sorghum in being hardy, it is a great drouth-resister and thrives under reasonably unfavorable conditions.

It can be planted at any time from the opening of spring until as late as July 1st with fair assurance of a crop. But as early harvesting and early marketing are especially desirable, it is usually advisable to plant it as early as Indian corn is planted, or from April 1st to 15th. If planted by the middle of April it will be ready to harvest by about the first of July. There is usually a lull in farm work about this time that makes it convenient for broom corn harvest.

There are numerous methods of planting it. It is planted in rows, checked and drilled. Drilling in rows gives the best results. The rows should be about 3 1-2 feet apart and the stalks about 6 to 8 inches apart in the rows on ordinary upland and a little thicker on bottom land. If it is planted too thin on good soil, the heads become so heavy that their own weight bends many of them down, forming the "crooks." This crooked brush is heavy but because it is more difficult to make into brooms and makes a larger bulk in shipping, it brings about half-price on the market.

Owing to its being a hardy plant, the cultivation of broom corn is often sadly neglected. It will make a fair showing on poor land with very little cultivation, but it responds to good treatment and should be cultivated as often and as thoroughly as Indian corn. After the first heads appear it is not long before it is ready for harvesting, and everything should be in readiness, because it soon depreciates in value after it is once ripe enough to cut. In order to make the best brush it should be cut when the seeds are in the dough stage. A small patch for seed can be left until fully mature.

The standard varieties are harvested by breaking two rows together in such a manner as to form a table upon which the heads after being cut off are laid to cure. It should remain in the field about a day. A light rain or a heavy due injures the brush. It is well if possible to cure it entirely in a shed. But if put in while green it must be placed in thin layers, which require considerable extra shed room. If left in the field, however, about a day after cutting, until it is nearly cured, it can be piled in good sized layers under cover, and seeded when convenient. The seeding is done by holding the brush on a cylinder similar to a thrashing machine cylinder. After it has been seeded, it should be bulked down in good sized piles and allowed to dry until the stems break quite readily.

Then it is ready to bale. Both the seeder and a baler for a small farmer can be made by any carpenter at a small cost.

The yield varies of course with the soil and locality, but a good average yield is a ton of thrashed brush from 3 to 5 acres. An experienced hand can cut about one acre a day. The thrashing and baling costs about $4.00 per ton. The price varies so much that the profits for one year can seldom be assumed as a standard. Ordinary brush one year with another averages about $60 to $70 per ton.

It is a good crop on the sod. It shades the ground and helps to rot the sod besides making as good a growth as Kafir or sorghum without cultivation.

The seed and the stalks are utilized for feed, but their feeding value is low and it would hardly pay to raise it for feed alone, although in the western part of Oklahoma dwarf broom corn is sometimes sown for roughness instead of sorghum because it does not sour in the stack so badly. After the brush is harvested the stalks can be used for forage and then plowed under making an excellent green manure.

There are many varieties of broom corn, but "Mammoth Dwarf," and of the standard varieties "Improved Evergreen," and "California Golden," have proven to be very satisfactory in Oklahoma. Seed can be secured from local raisers or from western seedsmen.

Broom corn is a "cash crop" and like other cash crops has favorable and unfavorable features. Its cultivation on a very large scale is seldom successful, but if properly handled on a small scale, say from 15 to 25 acres for the average farmer and especially on new land where the variety of sure crops is limited, it will prove to be as paying as almost any crop that can be raised. Oklahoma has early seasons and can market the brush early in the season, when the highest price is usually paid, and for that and other reasons should easily become a great source of the nation's supply of broom corn. (December, 1901).

## RAPE FOR EARLY SPRING FEED.

Each season's results at the Experiment Station give further evidence of the value of the rape plant as a source of green feed in this country. Not only has it proven a most desirable spring and fall pasture crop, but a crop that will furnish a large quantity of green feed during such a drouthy summer as that of 1901. The plant lived through the mild winter of 1900-'01 but the zero weather of the past winter killed all the plants.

The rape plant will be one of the first plants available for feed in the spring and a large area should be put out, as feed is scarce and high priced.

The value of the plant lies in the fact that it will furnish a large amount of green feed in a short period from the time of planting. The plant resembles the cabbage in texture and color but the growth is erect and two to three feet tall. Good rich soil is necessary for a large growth and should be put in fine tilth before seeding.

The plant is proof against frost and may be seeded the last of February or early March in Oklahoma.

Broadcasting will do for temporary patches but if the crop is wanted to last through the summer it should be in drills and cultivated. Do not pasture too close if continuous growth is desired. For broadcasting use three or four pounds per acre. In drills one to one and one-half pounds will be required.

Twenty-three tons of green feed per acre have been taken off at the first cutting at this Station. (February, 1902).

## ALFALFA IN OKLAHOMA

The farmer who knows the true value of alfalfa and has the ability to raise it has a great advantage over his fellows who do not. The time is not far distant when the greatest factor in determining the value of a farm will be its adaptability for growing alfalfa. Under no conditions nor with any combination of feeds, where alfalfa is not included, can the animal products of the farm be produced at the minimum cost, be they beef, pork, wool, mutton, or dairy products. The alfalfa crop of the past summer sold as hay in the winter market at a cash value of $30 to $40 per acre. Where properly utilized it has returned a greater value than the above when fed on the farm. For instance, a daily feed of 15 pounds per head with grain to fattening steers has saved one-fourth to one-third of the 60 cent corn, and where fed to young, growing stock, the showing is still more favorable.

Alfalfa as a soil improver stands at the head of the list. Due to its extraordinarily deep growing roots, it obtains its mineral food below where most plants feed. Like other legumes, it takes free nitrogen from the air by the aid of little organisms attached to the roots. Because of these two facts, alfalfa may be grown many years on the same land with the surface soil becoming richer all the time.

In some localities in Oklahoma, the acreage of alfalfa is considerable and the crop flourishes, while in other localities, failure seems to be the rule and of many acres seeded, very few remain now. Undoubtedly many of these failures have been due to very poorly adapted soil, but the majority of them are due to poor methods of preparing the seed bed, disregarding conditions at the time of seeding, and improper care of the crop after it has been started. A failure may be caused by any one of these or by a combination of them. It is a safe statement that where one acre of alfalfa is now grown in Oklahoma, one hundred might be grown.

Although the plant thrives on a large range of soils, the soil is an important factor in determining the success and productivity of the crop and on certain restricted areas, failure is certain. These are on soils where the rock is near the surface or that hold water to the degree of saturation for several days at a time. Where a stiff impervious clay comes within a foot or two of the surface, the growth of the plant will be weak and will be run out by crab grass unless very carefully nursed, and in unfavorable times this may fail to save it. On such soils the yield will be small. In the valleys of creeks and rivers where the soil is deep and rich and well-drained, alfalfa reaches its maximum but it can be grown on soils not nearly so favorable and very profitable results may be obtained.

The beginner should select his very best piece of land for a start, so as to make success as sure as possible for if he once learns the value of alfalfa, he will make it succeed on almost any soil. But most of the failures of alfalfa in Oklahoma are due to poor methods of starting the crop and improper care after it has been established. Crab grass is a great pest to alfalfa as well as to other crops in this country. The writer has seen new seeding alfalfa get a start of eight to ten inches with a perfect stand and the crab grass catch it and smother it out before fall, and this when the mower was used. The point is that it is folly to seed a field of alfalfa without subduing the crab grass. On the stiff heavy clays, the alfalfa will make a weak growth and the crab grass wil flourish to perfection generally taking the field if stern measures are not employed to check it. On this foul land, preparation of the field for seeding alfalfa should commence a year or two previous to the time of seeding. One year in a crop that can be thoroughly cultivated throughout the season to keep any crab grass from going to seed is a good starter. Follow this with a crop next spring like oats that can be removed early. Plow deep and thoroughly as soon as the crop is removed and keep soil in fine tilth by frequent harrowings every week or two as the weeds start, or after each rain to break the crust. The ground wants to be well settled with a well pulverized surface. Alfalfa seeding on newly plowed ground is a failure as a rule because the ground is too loose and open.

The time of seeding alfalfa permits of considerable variation, both spring and fall giving good success when other conditions are given due consideration. Fall seeding has a better chance to get started ahead of the crab grass. Seedings from the middle of September to the last of October have given good results in this country. Spring seedings should not be made until the ground is warmed up and the danger of cold rains is past; about the last of March as a rule in Oklahoma. Late spring seeding will be bothered more with crab grass. But the condition of the seed bed must be suitable before seeding is made at any time. There must be moisture enough to start the seed at once, if not, wait; wait if it is six or twelve months. If the soil has been in fine tilth as long a wait as this will seldom be necessary.

Twenty pounds of good seed per acre should be put in. This may be broadcasted but drilling is a surer and more satisfactory method. A common grain drill may be used. It may be necessary to mix the seed with some material such as fine corn meal to get the drill to sow the proper amount.

The first year is a critical one with alfalfa and the weeds and grass should be kept down by frequent mowings made at the proper times. No stock should be pastured on alfalfa during the first and second years. The statement is often made that when alfalfa is once established, it will take care of itself. This is not true on many Oklahoma soils. The crab grass will gradually work in and the alfalfa will go out if something is not done to check the grass. This will be the usual result if alfalfa is pastured. The only way that the crab grass can be checked is by disking several times during the crab grass season just after the alfalfa has been cut. The disk must be set deep to have good effect. Harrow down thoroughly after disking. A disking in July and one in August will be necessary to keep the crab grass down.

Alfalfa should be cut after the plants make a good start to bloom; wilting only should be allowed in the swath. The curing should be done in small piles and the hay put in the stack before it is fully dry so as not to lose the leaves. (February, 1902).

### FEEDING WHEAT.

Feeding wheat to farm animals is not a novelty to the farmers who passed through the years of '93, '94 and '95 in this country, as many thousand bushels were fed during that time. Due to a very severe drouth which has caused almost a total failure of corn the farmer now has the choice of feeding wheat; of which he fortunately has plenty; or letting his stock go without grain. At 57 cents per bushel, wheat is by far the cheapest grain within his reach, and if the price of fat stock is maintained it can be fed with profit if the proper methods are followed. The feeder has the advantage of the experiences gained from '93, and '94. and any one not familiar with them should get them as they have been widely published in reports and papers.

The value of wheat for hog food has been demonstrated by practical feeders and the Experiment Stations. Pound for pound it is equal or slightly superior to corn when properly fed. A bushel of wheat will produce from 12 to 15 pounds of pork when fed to thrifty shoats. Grinding at five cents per bushel pays well since when fed whole and dry about one-fourth passes through the hog undigested. Soaking does not lessen this materially, although the results are some better. Feeding sheaf wheat to fattening hogs has not proven economical but with pigs and stock hogs on a light grain feed it is practiced with good results.

Little definite information is on record in feeding wheat to cattle although hundreds have been so fed with good results. In the few experiments at Experiment Stations in this line, wheat has been fed mixed with other grain. When fed this way it has given results fully equal to corn. At the Ohio Station steers fed on a mixture of wheat meal and bran required 6.7 pounds of grain to produce a pound of gain. At the Kansas Station twelve steers fed on wheat meal for 63 days required 5.72 pounds of grain for each pound of gain. This is 10.5 pounds of beef from a bushel of wheat. The 63 days were the first part of feeding period. When the grain fed was limited in amount the steers ate it well without getting off feed. A thousand pound steer should not be fed over 16 to 18 pounds of wheat meal per day as wheat will surfeit a steer more readily than corn meal. Ground is the only condition in which to feed wheat to cattle and better results will be obtained with this if it can be mixed with bran or cotton seed meal.

Wheat meal makes good feed for dairy cattle but should be fed with alfalfa, bran, cotton seed or cottonseed meal, for the best results.

With sheep, wheat feeding has been very successful as the grain gives the best results when fed whole and dry, and the cost of preparation is saved. At the Michigan Experiment Station wheat fed to lambs returned 100 pounds gain for each 553 pounds of grain fed.

Opinions differ much on the merits of wheat as a horse feed. Due to improper methods of feeding, many poor results have followed but this does not detract from its worth for this purpose. Whole dry wheat cannot be fed to horses with good results, especially to work or driving horses. Soaking it improves some but grinding is by far the best method of preparing it for horses, but if it is fed as an exclusive feed, even in this condition, care will be necessary to avoid colic at times. Much better results will be obtained by mixing half bran, oats or corn with the wheat or mixing it with chopped feed.

The composition of wheat is such that for the animal to make the best use of it some food rich in protein must be added. Cottonseed meal can be used in most cases for this purpose. When corn or wheat is 25 to 30 cents per bushel this consideration has not much importance, but with the present prices the saving made by balancing up the ration will be considerable.

There will be considerable question as to how wheat will pay out this year when fed to fattening stock, but there can be no question but that it will pay to feed it to growing and breeding stock rather than to sacrifice them or let them suffer and deteriorate. (August, 1901).

### STOCK FEEDING.

This is a winter of high prices for feeds, and it behooves every feeder to put much thought and skill into his operations that he may have the balance on the right side of the ledger at the close. Fat stock are bringing good prices and no doubt will the rest of the winter; and there is as much opportunity for profit in stock feeding in Oklahoma this winter as there has been any winter in the past. All that is necessary is to feed the right kind of feeds in the proper manner and combinations, to good stock.

The Oklahoma Experiment Station has published several bulletins on the value of different feeds and their proper combinations.

To compound the proper ration, (according to feeding standards,) and the most economical ration, the feeder must take into consideration the market price of the feeds and the amount of digestible nutrients they contain and the character of the nutrients or compounds. Each nutrient in a feed performs more or less of a special office or work in the keeping up or building up of the animal body. For some purposes in the process of animal nutrition any of these compounds in the feeds will supply the want and do the work; but there are some functions in this process of building up of the animal body that require a certain one of these compounds or nutrients and no matter how much of the other compounds is present in the feeds they cannot take the place of this nutrient which is called protein. It goes to form blood, lean meat or muscles, hide, hair, milk, wool, and other like products that contain nitrogenous material in the animal body. As a rule for feeding purposes, the value of a feed depends largely upon the amount of protein it contains. For instance, every hundred pounds of corn contains 7.9 pounds of this nutrient, protein, that is digestible. Cottonseed meal contains in every 100 pounds 37.2 lbs. When corn is worth 60 cents per bushel or $1.08 per hundred, cottonseed meal is worth about $40 per ton. This is when based on the amount of protein that the two contain, and to realize anything like these comparative values the feed must be fed in the proper combinations, etc. For instance, for an exclusive feed for almost any kind of stock, corn is worth more per hundred than cottonseed meal. There is just as much loss of the nutrients in feeding when too much protein is feed, as when too little is fed. An example of the former case would be where nothing but cottonseed meal was fed and when nothing but corn was fed would be an example of the latter case. When feeds are very cheap these losses may not count for much but when feeds are high priced, as they are this winter, it is very important to see that the combinations of the feeds are such that they will furnish the different materials in the proper proportion to the animals, in order to make the waste as little as possible. The above comparative prices put on corn and cottonseed meal might be said by some to be theory but numerous experiments at the Experiment Stations have demonstrated that they have this approximate value when fed in the proper mixtures, amounts and manner.

The Experiment Station will figure out rations for those that cannot, if they will write and state what kind of feeds they have and the market price and the kind of animals they want to feed it to, and the approximate weight and age of animals.

The following table will aid in determining the best and cheapest feeds to use and combine.

| Market price and digestible nutrients per 100 lbs. of the following feeds: | Price per 100 lbs. | Protein, lbs. per 100. | Carbohydrates and Fat Equivalents | Total Digestible Nutrients |
|---|---|---|---|---|
| Wheat Straw | $ .15 | .4 | 37.2 | 37.6 |
| Cotton Seed Hulls | .15 | .3 | 36.9 | 37.2 |
| Alfalfa | .60 | 11. | 42.3 | 53.3 |
| Oat Straw | .25 | 1.2 | 40.4 | 41.6 |
| Prairie Hay | .40 | 3.5 | 45. | 48.5 |
| Corn Stover | .30 | 1.7 | 34. | 35.7 |
| Cotton Seed Meal | 1.25 | 37.2 | 44.4 | 81.6 |
| Cotton Seed | .70 | 12.5 | 68.9 | 81.4 |
| Oats | 1.25 | 9.2 | 56.8 | 66. |
| Bran | 1.15 | 12.2 | 45.3 | 57.5 |
| Wheat | 1.00 | 10.2 | 73. | 83.2 |
| Kafir Corn, whole | 1.08 | 4.7 | 32.6 | 37.3 |
| Kafir Meal | 1.12 | 5.8 | 56.5 | 62.3 |
| Corn | 1.08 | 7.9 | 76.4 | 84.3 |

Bear in mind that the total amount of digestible nutrients in a feed goes as much toward determining the value of a feed as the amount of protein it contains.

The above feeds must be in the normal condition to contain the given amount of digestible nutrients. For instance, if corn stover or prairie hay were cut at the wrong time or allowed to get wet or are otherwise handled improperly, they might not contain more than half of the amount given above.

The following is given as answers in part to the many inquiries received by the Experiment Station about feeding cotton seed and cotton seed meal.

Steers give the best returns when properly fed on cotton seed or cottonseed meal.

The following results were obtained at this Station during the winter of 1899-1900. The results are for four lots of steers containing five steers in a lot, and for 35 days.

The daily gain per steer was 2.6, 3.2, 2.45, and 2.99 lbs, respectively.

Grain eaten per pound gain was 8.02, 6.54, 8.73, and 7.01 lbs.

The grain for the first and third figures was Kafir meal 18 parts cotton seed 4 parts, cotton seed meal 2 parts. In the second and fourth corn meal took the place of Kafir meal.

To realize the value of this showing, the fact must be known that the 35 days were the last of a feeding period of 147 days, and that in the first 112 days of the period the steers had made good gains. Where cotton seed or cotton seed meal are mixed with corn, Kafir corn or wheat, steers made most excellent gains and this is the most economical way to feed it. Roughly, from four to six pounds of the meal mixed with 16 to 18 pounds of ground corn, Kafir corn or wheat will make a good daily ration for a 1000 pound steer if he has good roughage.

Near the oil mill it is quite a practice to feed no other grain but cotton seed meal mixed with the hulls in the proportion of one of the former to three or four of the latter. Experiment Station trials go to show that much better gains can be made for the amount of grain consumed when corn chop or some other like feed is a part of the ration. Even at the present price of corn and wheat it will pay well to buy wheat or corn to mix with cotton seed meal for steers.

Steers can be partially fattened exclusively on cotton seed, but they will not eat enough of it per day (about 13 lbs) to enable them to make the best gains.

The Texas Experiment Station considers 33 1-3 pounds of cotton seed worth about as much as 28 pounds of corn for steers and dairy cows. This makes cotton seed quite valuable this year. Cattle want to be brought onto a feed containing cottonseed very gradually.

Cotton seed and cotton seed meal are most excellent feeds to feed with other grains for dairy cows. Not more than 3 to 4 pounds of the meal should be fed per day. When fed in small quantities, 3 or 4 pounds per day, cotton seed meal may be fed indefinitely to steers and cows without injury to them, but if fed in large quantities, they may go blind in about 90 days. At this Station rough yearling steers have been fed the whole winter on a ration of 4 pounds cotton seed meal and 2 pounds of corn and what roughage they would eat, and with good results.

Some deaths have resulted from feeding cottonseed meal to calves, but others have had good results.

It is generally conceded that cotton seed or cotton seed meal should not be fed to swine as many of them so fed die after three or four weeks feeding on it.

But before letting swine want for the proper ration, it is well to consider the proposition of feeding them some cotton seed meal. In the experience of the feeder with a large number of experiments, cotton seed meal mixed with corn or Kafir corn has given the best of gains, but there has been some loss from hogs dying. But we think that the risk of loss is so small with our method of feeding it that all hogs on the Station farm will have cotton seed meal as a part of their ration this winter. The ration should consist of about 1-5 cotton seed meal and 4-5 corn, wheat or Kafir chop. This should not be undertaken unless the risk of losing a hog or two can be taken, and the proper methods are followed. In our judgment, the feed and cost that will be saved will over balance any hogs that we may lose.

Horses have been fed cotton seed and cotton seed meal in small quantities mixed with other grains with the best of results. Such a mixture would be the superior to a single grain as corn and this winter would lessen the cost of feed very much.

In all feeding, stock should be put on a grain gradually, and changes must be made very gradually, and care must be taken not to feed too much. (October, 1901.)

## WHEAT MEAL, BRAN, AND SHORTS.

The feeder is frequently in doubt as to which is the cheapest, wheat meal, bran, or shorts when purchasing feed for cattle and hogs.

If wheat meal costs $20 per ton, is it cheaper than bran at $15 or shorts at $16 per ton? Other considerations aside from arithmetic enter into the answer to this sort of questions. In the first place, the material sold as bran varies from the hulls of wheat to a mixture of the entire refuse from flour manufacture known as 'millrun.' And material sold as shorts is often mixed with bran in varying amounts. As used here, bran means material produced as a by-product of milling from which shorts have been separated. It should be flakey, light and bulky, and of the color of the wheat hull. Shorts on the other hand, should be fine, grayish in color, and free from all except small particles of the wheat hull.

The value of a feed, as a rule, is estimated on the basis of the amount of protein, carbohydrates and fat, and the total nutrients which it contains. These words are too aften meaningless and will be better understood if protein is thought of as that part of a feed that makes growth; 'muscle-makers' is sometimes used to explain this term. Carbohydrates and fat are the fat formers; they also serve to keep up the heat of the animal body. By total nutrients is meant the sum of the compounds or substances in a feed that contribute to the nutrition of animals. Another term, nutritive ratio, is used to designate the proportion between the protein and other compounds in a feed. It is obtained by dividing the number of pounds of protein in 100 lbs. of a feed into the number of pounds of carbohydrates and fat.

The following table shows the composition of wheat meal, bran, and shorts expressed in the above terms.

| FEEDS | Pounds in 100 Pounds | | | Nutritive Ratio |
|---|---|---|---|---|
| | Protein | Carbohydrates and Fat | Total Nutrients | |
| Wheat Meal | 10.2 | 73.0 | 83.2 | 1:7.2 |
| Wheat Bran | 12.2 | 45.3 | 57.5 | 1:3.7 |
| Wheat Shorts | 12.2 | 58.5 | 70.7 | 1:4.8 |

If the total amount of nutrients determined the value of a feed, it would be a simple matter to decide which is the cheapest. On the basis of total nutrients, if wheat meal costs $20 per ton, wheat bran should cost $13.80 per ton and shorts $16.87. But the requirements of the animal to which the feed is to be fed must also be considered. The nutritive ratio of the ration fed to hogs and cattle may vary within reasonably wide limits. As a rule, however, the grain ration should have a nutritive ration from 1:5 to 1:6.5. The feeder who keeps within these limits, while he may depart from theoretical standards, will do better than if he feeds without system and without figuring.

It will be seen from the table that wheat varies on one side of the standard and bran and shorts vary on the other. Thus it appears that a mixture of wheat meal with either bran or shorts would be cheaper than any one of them alone; even though the cost be greater.

For example, if wheat meal costs $20 per ton and shorts $16 per ton, a mixture of equal parts of each will cost $18 per ton. This mixture would contain in each 100 lbs. 11.2 lbs. protein and 65.7 carbohydrates and fat making 76.9 lbs. total nutrients, and would have a nutritive ratio of 1:5.9 which would be better to feed than either wheat meal or shorts alone. When wheat meal is fed alone, there is an excess of carbohydrates and fat. In shorts there is an excess of protein. In the mixture, these are balanced, giving what is called a balanced ration.

Each set of conditions requires different management and in this season of high priced feeds, the feeder must use pencil and paper wisely if he is to come out on the right side. The Experiment Station will calculate rations for Oklahoma feeders who desire it. The letter of inquiry should state the prices of different feeds, the character of roughness on hand, and the kind, age, and weight of the animals in order that the most economical ration may be suggested. The above remarks concerning wheat meal, bran, and shorts show how difficult it is to arrive at an exact decision when comparing the cost of feeds and how necessary it is to study feeds and their composition in order to feed to best advantage. (November, 1901.)

## FALL PLANTING OF TREES.

Young trees that are bought from the nursery should be planted in the fall. Over ninety-five per cent of the nursery trees are dug in the fall and exposed to the sun and wind all winter without sufficient moisture to keep the trees in perfect condition. These trees should be delivered in the fall and set out in the orchard before January. The sooner the trees are set in the orchard after being dug the better. The trees should be well planted and the moist soil pressed firmly about the roots. The top of the trees gives off moisture in the winter through the bark, and the roots must be well packed in moist soil to supply this moisture; a condition which seldom exists when the trees are in temporary quarters. If the trees are set in the fall, the soil settles around the roots in the winter and will be full of moisture and the trees are ready to start into full and rapid growth in the spring. November and December are usually the best months for transplanting trees and shrubs.

Trees set in the spring will usually grow and do well but the results are not so uniformly satisfactory. The trees are seldom in as good condition for spring setting as for fall. (October, 1901).

### PLANT TREES AND CARE FOR THEM.

Governor Ferguson of Oklahoma prefaced his arbor day proclamation with the following appreciation of the beauty and utility of trees:

"In all ages men have loved trees. The beauty of their foliage, their grateful shade in the heats of summer, and the protection of their encompassing branches from the blasts of winter, led primitive men to build their homes in the forests. Trees made it possible for men to pursue the trackless ways of the seas, and from their trunks, were carved the very sinews of civilization. Year after year, the blossoming of trees gladdens the hearts of men with the promise of renewed life. To plant trees is to assist nature in perpetuating one of her most priceless gifts to humanity."

Arbor day is fixed by legislative enactment and Friday, March 14, has been so designated in 1902; a time when trees may be planted with every promise of success.

Trees add much to the comfort, beauty, and value of the home, whether it be in the city or in the country. The value of shade trees about the house is appreciated almost every day from May until October, and no effort to increase the number of trees is wasted. A grove, if well cared for, increases the value and productivity of the farm. The greatest benefit is realized when the grove is placed so that it will form a wind-break on the south and west sides of the orchards and on the north side of the barns and feed lots. This location need not interfere with the grove's producing a constant supply of posts and fire-wood.

There are many trees that, if given proper attention, grow rapidly in Oklahoma. Some of these may be taken from the native forest and all may be obtained from nurseries at a reasonable price and in first-class condition for transplanting. Nursery-grown trees usually grow better when transplanted than those taken from the native forest. The small forest trees are usually sprouts from old stumps and cannot be taken out with a good root system for transplanting. Trees in a native timber are accustomed to shade and they suffer when exposed to the direct heat of the sun and to the wind.

The soil in which trees are to be planted should be given as thorough preparation as for any other crop. It should be plowed to a depth of at least eight inches and firmed down by repeated harrowings. Where trees are to be planted for shade the holes should be dug large and deep, three feet each way is not too large, and filled in with surface soil to the depth at which the trees are to be set. This work should be done as long as possible before the time for planting the trees, and if now, the soil that is filled into the holes should be saturated with water before setting the trees. Trees that do not have good roots should not be set where they will be exposed to the direct force of the wind. When transplanting, set the roots at about the same depth as that at which they grew naturally, and press the soil firmly about the roots. This is a very important point and frequently neglected.

Trees should be pruned when set. The broken and crushed roots should be cut back to sound wood; they usually are cut short enough in digging. The tops should be cut back so as to properly balance them with the roots; one year old trees may be cut back to the ground, two year old trees should have about half of last year's growth removed, and older trees should be pruned quite severely. No set of rules can be followed in all cases and individual judgment must determine what is to be done with each tree.

In planting for a grove, the trees may be set three or four feet apart in rows seven or eight feet apart each way, or in check rows four or five feet apart each way. The first method will admit of cultivation for a longer time than the second and thinning will not be necessary for a longer time. Trees one year old are suitable for grove planting and may be set in furrows plowed for the purpose after the soil has been put in good condition. In every case the trees should be set thicker than they are expected to stand when grown. It is easy to remove a tree.

Trees set in isolated positions are especially exposed to the hot sun and attacks of borers. In such places, the trunks of trees that are taken from the native forests should be protected during the summer by standing a board on the southwest side of the tree.

The trees most generally planted have been elm, soft maple, catalpa, black locust, and box elder. The elm grows slowly at first and is attacked by borers, but it is the best shade tree in the list and should be included in every planting for shade. The soft maple is easily broken by the wind and suffers from drouth and the attacks of borers, but it grows rapidly from the start and makes a pretty tree. The limbs of the catalpa are easily broken by the winds, but it grows rapidly, makes a fair shade, and is valuable timber for posts.

The black locust is not generally regarded as a first class shade tree and its tendency to sprout from the roots makes it somewhat objectionable on lawns. But it is the fastest grower in the list, will stand more neglect than the others, and the wood is very durable for posts. The box elder is a moderate grower and is not adapted to poor, upland soil, though it does well in favored location. The ash, and sycamore are good trees, but are not adapted to as wide a range of soils as the others.

While the present season does not afford the best of conditions for planting trees, success may be had by all who make an earnest effort. The holes should be well watered when the trees are set and if there is a shortage of rainfall up to the time that growth starts more water should be supplied. After the growth has started and the soil is once filled with moisture, it is then a matter of cultivation. The soil at all times within at least three feet, and better ten feet, of the trees should be kept loose on top and free from grass and weeds. If there are fifty trees or less they should be hoed after every rain; it can be done in an hour. Where the trees are in rows, cultivation with horse tools is cheaper and as effective. Dirt should not be piled up around the base of the trees so as to run water away from them. It is better to have a basin-shaped depression to catch the water that falls and let it soak in.

The planting of trees is commendable and cannot be too strongly urged upon any one who owns even ten square feet of land. But the planting is the least part of the operation. The daily, weekly, and monthly care which is given the tree during the first ten years after transplanting determines whether or not the tree will continue growing. None but those who love trees can succeed in growing them in Oklahoma but nowhere else is care and attention more abundantly repaid. (March, 1902).

### CULTIVATE THE TREES.

Many of the trees that were planted for shade and fruit this spring are already dead. Many more will die before the summer is past. The chief cause for this loss has been and will be neglect. Assuming that the trees have been planted properly and that they were of sorts adapted to Oklahoma conditions, at least ninety-five per cent of those planted should live and thrive. Orchardists as a rule give their trees every needed attention and lose but few trees. The most notable example of intermittent enthusiasm may be seen along the streets of towns and cities. When spring comes, nearly every one plants trees as a matter of course or to get rid of some tree agent. Too often when the planting is done, no further attention is given. After planting, the dirt is often piled up in a nice mound about the base of the trees possibly with the notion that this will hold the tree in place. The result is that what rain falls is drained away from the roots of the trees instead of toward them. In stead there should be a slight depression about the trees so as to get a little excess of water if possible and let it soak in. Cultivation throughout the summer should be given if trees are wanted. The growth of the trees will be better if all the space between them is cultivated after every rain. This is hardly desirable about the house and the next best thing is to cultivate a space about the trees. The soil should be hoed and kept loose for a space of from three to five feet about the trees, the larger the cultivated space, the better. It isn't a hard matter to grow trees if one will give them a little attention right along and will think of them as a crop that should be cultivated if good growth is expected. A treeless town is always cheerless to the stranger, while streets bordered with thrifty trees are attractive and are appreciated by all. Cultivate the trees every time it rains and sometimes between times. (May, 1902).

## LOCO INVESTIGATIONS.

The Experiment Station has under way some experiments and studies concerning the "loco weed." This well known weed is fairly well distributed over the western half of our territory and is a source of considerable loss to the stockmen of the region mentioned. Probably all cattlemen are familiar with the symptoms exhibited by the so-called "locoed" cattle but as yet the exact nature of the poison contained in the loco has not been determined—the fact is that many doubt the existence of any specific poison in the loco plant. Investigations regarding this poisonous principle and the general nature of locoism are now being conducted by the veterinarian of the Station and it is hoped this work will yield some positive results regarding this subject.

For some time stockmen have known that the loco plant was more common some years than others but no very definite reason has as yet been given for this phenomenon. It has been suggested that the loco weed during certain years is largely destroyed by insects that make their appearance during certain years in abundance. Some preliminary field work seemed to make this explanation quite reasonable and the botanist and entomologist of the Station has commenced a thorough study of the insects known to infest the loco. Some interesting facts have already developed along this line but some time must elapse before the final announcement of the results of the work can be made.

The final object of the work is to offer the stockmen some relief from the great losses they are now suffering and the Experiment Station therefore desires to secure the hearty co-operation of all persons interested in the extermination of the loco weed from the ranges. It is especially desired that all persons interested in the subject send in full statements regarding the possible connection of the loco eating habit and rather the common occurrence of abortion among cattle. The losses from this source among stockmen are very great and many seem inclined to think that the abortion is caused by the eating of the loco plant. In fact it is not uncommon to have other evil effects connected with the eating of loco. All these questions will receive attention during the investigations.

It is particularly desired that specimens of the loco plant and all the insects found upon the plant be sent to the Station for examination and study. These specimens may be sent by mail enclosed in a pasteboard box of proper size. Such assistance as that mentioned will do much to hasten on the work along this line now commenced. (August, 1901).

## PROTECTION AGAINST PLANT-DISEASES AND INSECTS.

Plant diseases and insects are doing so much damage to the orchards and gardens in Oklahoma that it has become necessary to protect the plants by some artificial means. The method of destroying the diseased and wormy fruit and foliage is of great value if persistently carried out. This cannot be done in so thorough a manner, however, as to destroy all the diseases and insects present, and a few left over and those that will come from neighboring farms will produce a dangerous number next year. The cheapest and most practical method of protecting plants from diseases and insects is spraying. The ideal method is to spray thoroughly and then destroy all diseased fruit, leaves and trash about the orchard and garden. Either method is good when used alone and the value of each is greatly increased when used together.

Spraying solutions are divided into two general classes. Those designed to prevent the attacks of fungus diseases are called fungicides and those designed to destroy or prevent the attacks of insects are called insecticides.

Fungicides protect the plants by preventing the fungus diseases from gaining a foothold on the plants. The solutions are composed of materials that destroy the germinating spores where it comes in contact with them. The copper and sulfur compounds are the most effective materials used in these solutions. Most of the fungus diseases of plants that can be prevented by spraying reproduce by means of two kinds of spores. One kind of spore is produced in the spring and summer and germinates soon after maturity. If the spore finds lodgment on tender growing parts of the plant and a favorable amount of heat and moisture is present germination and growth immediately follow. If these spores do not soon germinate they lose their vitality. This process of germination, growth and fruiting goes on during the spring and summer. Late in the season another kind of spore is produced, which is capable of passing through the winter and germinating the following spring. The germinating spores send the roots directly into the tissue of the plant, unless it is a surface growing fungus, in which case the roots spread over the surface of the plant. If the plants are covered with a good fungicide when the spores germinate the spores will be killed.

There are two general classes of insecticides. The first class of mixtures contains some poisonous substance that kills the insects when it is eaten with the foliage or fruit on which it has lodged. Paris green, London purple, and white hellebore are the poisonous materials most commonly used in these mixtures. These mixtures are effectual in destroying only those insects that eat the foliage or fruit of the plants, and are harmless to the insects that suck the juice of the plant.

The other class of insecticides kills the insect by coming in contact with the body. Kerosene emulsion, whale oil soap, and pyrethrum powder are the most common materials used in these mixtures. Mixtures of this class are used chiefly to destroy those insects that suck the juice of the plant and cannot be destroyed with poisons. The poisonous insecticides may be mixed with fungicides and applied all in one spraying, but other insecticides must be applied separately.

The fungicides and insecticides, if properly prepared and applied, have no effect upon the plants. If the mixtures are not correctly prepared and applied they do not form the desired protection to the plants and may damage the foliage and fruit. There is never enough poison on the well sprayed fruits and plants to alter their value for food. Most fruits are pared before eating and all sediment of the spraying material removed. In the case of fruits that are not pared before eating, as grapes, a person would have to eat from 350 to 500 pounds to get a small dose of poison. It will always injure the sale of such fruits, however, if there are any signs of a spraying material on them when placed on the market.

There are several kinds of spray pumps on the market that can be purchased for eight to twelve dollars that will do all the work on the average farm. The best form of pump for the ordinary farm orchard is a compact strong barrel pump. It should have a good sized air chamber and be capable of throwing a good quantity of water with great force. The working parts should be made of brass and if all parts of the pump that come in contact with the liquid are of brass the life of the pump will be greatly increased. Agitator attachments can be purchased as part of the pump or as separate machines. These attachments are very convenient but are not necessary; the agitation of the liquid may be done with a board, by hand.

The pumps should be supplied with about fifteen or twenty feet of one-half or three-quarter inch rubber hose for each nozzle attached. A good length of hose will save a great deal of time and trouble about reaching all parts of the trees and vines.

The nozzle should make a fine spray and be able to throw it several feet. There are two well defined groups of nozzles now in use. The first group forms the spray by forcing the liquid against an obstruction at the outlet of the nozzle. These nozzles throw a fan-shaped spray and most of them can be adjusted to throw a very fine spray or as coarse a spray as may be desired, or even a solid stream. These nozzles are easily opened and cleaned of any clogging material that may lodge in them, by adjusting them to throw a solid stream. This form of nozzle is best adapted for general use.

The second group of nozzles gives the liquid a strong rotary motion just before it leaves the nozzle. This causes the liquid to form a funnel shaped spray. These nozzles form a very fine spray and for applying liquids that are not liable to clog are a very good form.

The spraying must be well done if it is to be of any value. Slipshod work will never pay. It is just so much time and material used and still the plants are not protected. The liquid must be applied in the form of a very fine mist or spray. If the liquid is thrown on the plants in large drops it collects and runs off, but if thrown on in a fine mist the foliage and fruit can be wet on all sides and but little liquid reach the ground. The liquid must be applied from every direction so that all parts of the foliage and young shoots will be wet. If the top of the tree is very dense the nozzle should be held in the center and the spray thrown in every direction. The work cannot be done in a hard wind. The side of the plant next to the wind will be washed and the opposite side show little signs of the spray. The greater the power applied to the pump the better the form of spray thrown by the nozzle.

Spraying is a preventive and not a remedy. There are a few fungus diseases that can be destroyed by spraying but they can also be prevented by the same operation. The damage done by a disease or insect can be repaired only by the plant itself, and such work as can be done to protect it from further damage is about all that can be done for it. The spraying should be done early and the protection made complete before the disease and insects appear. The first spraying should be done in the orchard, vineyard, and berry patches just before the growth starts in the spring. The second application should be made ten days or two weeks after the first and the third about two weeks after the second. If the orchard or vines are badly infested a fourth application should be made about two weeks after the third. If an application is followed immediately by a hard rain the application should be repeated as soon as possible. If this plan is followed and the work well done with properly prepared mixtures there will seldom be any need of further attention in this direction during the season. The solutions used in these sprayings should be a combined fungicide and insecticide, preferably Bordeaux mixture and Paris green. If the directions are followed they will meet the requirements for preventing about ninety per cent of the common fungus diseases and insects pests. There have been a great many spraying calendars published giving long lists of diseases and insects with specific directions for preventing each one. A careful examination of these calendars shows that a large majority of the treatments recommended are covered by those given above.

The Bordeaux and Paris green mixture is prepared as follows: Dissolve 4 pounds of copper sulfate (blue vitriol) in 2 or 3 gallons of water by placing the sulfate in a sack and suspending in the top of a jar or tub of water. Do not put this in tin or iron vessels as it will rapidly dissolve them. Before mixing dilute this to about 20 gallons. Slake 4 pounds of fresh lime by adding a small amount of water and after slaking is finished add about 20 gallons of water. Stir the lime and water thoroughly and strain before mixing. Pour these two solutions into the barrel or tank at the same time and stir vigorously while mixing. This may be diluted to 50 gallons and is the Bordeaux mixture. Make about one-fourth of a pound of Paris green into a thick paste with water and add it to the Bordeaux mixture and stir thoroughly and the mixture is ready for use.

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# Oklahoma Agricultural Experiment Station,

STILLWATER, OKLAHOMA.

BULLETIN NO. 60, DECEMBER, 1903.

# PLANTING TREES

## FOR POSTS, FUEL, AND WINDBREAKS.

### INTRODUCTION.

There is much interest among farmers generally concerning the important subject of providing home-grown posts and fuel. The Station has been collecting data and conducting experiments along this line for several years and the following brief notes are believed to indicate the proper methods for Oklahoma generally. The information on which the recommendations are based is not confined to the results obtained on the station farm, but includes that derived from reports of succesful tree planters throughout the Territory and from personal examination of many widely scattered plantings. The station appreciates the kindness of those who have given assistance and thus aided in extending the scope of the inquiry and adding to whatever of value there may be in the results. The station has no tree seeds or trees for sale or distribution but those desiring to purchase any of those mentioned will find no difficulty in obtaining them from local seedsmen and nurserymen.

### COLLECTION OF TREE SEED AND PROPAGATION AND CARE OF SEEDLINGS.

The farmer who contemplates planting forest trees must grow his own trees from the seed or buy them from the nursery. Buying the trees from the nursery will incur a greater expense than most of the farmers in Oklahoma feel able or disposed to bear though often it is more economical than growing them. The purchase of the seed to start the trees is an item of considerable importance to many. A start can be made quicker if the trees are purchased and set this winter, but if this expense cannot be borne then the seed should be secured and a small nursery started on the farm. Farmers can, with little expense, give the cultivation and care necessary to grow a few hundred trees in the nursery row.

A little care and labor will frequently avoid the expense of buying seed of most of the common trees. In all of the older sections of Oklahoma there are many trees under cultivation that produce seed which can be had for the gathering. Many of the native trees are well worth cultivating for wind-breaks and timber supply on the farm and all of these trees produce seed in abundance. There is little demand for tree seed, it is difficult to gather, and many kinds will not grow after they are one year old. These three conditions are the predominating cause of the high price of tree seed.

The following table gives the approximate cost and number of seeds per pound of the kinds of trees most commonly used in plantings for wind-breaks and wood-lots.

| VARIETY. | No. of seeds Per pound. | Approx. cost Per pound. |
|---|---|---|
| Ailantus | 20000 | $0.60 |
| Black Locust | 30000 | 0.40 |
| Black Cherry | 4000 | 0.60 |
| Black Walnut | 25 | 0.05 |
| Box Elder | 15000 | 0.60 |
| Catalpa | 20000 | 0.80 |
| Elm, White | 92000 | 1.50 |
| Hackberry | 3000 | 0.80 |
| Honey Locust | 2500 | 0.40 |
| Osage Orange | 10000 | 0.40 |
| Red Cedar | 8000 | 1.00 |
| Russian Mulberry | 200000 | 2.00 |
| Shell-bark Hickory | 50 | 0.15 |
| Soft Maple | 2000 | 0.70 |
| Sycamore | 120000 | 0.80 |

## COLLECTING, STORING, AND PLANTING THE SEED.

The time for collecting forest tree seed extends from April to November. The seeds should be gathered as soon as they are ripe. The earliest ripening seeds fall as soon as they are ripe. The elm and soft maple ripen their seeds in the early spring and these should be planted the same season and produce plants during the summer. The best success can usually be had with tree seeds that ripen before the middle of the summer by planting them as soon as they are ripe. These early maturing seeds germinate and grow readily, and if well cared for will produce plants a foot or more in height the same season.

The late-maturing seeds will frequently cling to the trees for some time after they are ripe. Ash and box elder seed will frequently cling to the trees long after they are ripe and have become so dry that but few of them will germinate. All of these late maturing kinds should be gathered as soon as they are ripe and placed in storage. The degree of ripeness of the seeds can be determined by the brown and yellow tints of the seed coverings. Seeds that have fleshy pulp like the hackberry and mulberry should be gathered when the flesh of the fruit is ripe. If the flesh is thick it should be removed from the seed before it dries. The large seeds like walunts and pecans can be gathered from the ground after they have fallen from the trees. Seeds that are in pods as the locust should be thoroughly dried, shelled out, and stored. Many of the seeds will be freed from the hulls if well dried and thrashed. Walnuts can easily be hulled by running them through a hand corn sheller. Seeds that are covered with pulp like the mulberry and red cedar should be macerated and the seeds washed out with water and dried before storing or planting.

Acorns and nuts and the seeds of the black locust, honey locust, ash, hackberry, sycamore, kentucky coffee tree, and red cedar should be buried in sand or soil in the fall and left till planting time in the spring. The seed should be kept moist, not wet, and should be exposed to freezing temperature. If spread on a cellar floor most of them will keep well. Seed of catalpa and osage orange should be kept in a dry, cool place, but the latter will do very well if stored in cold, moist earth.

As there are few kinds of tree seed that will germinate well after they are more than one year old, great care should be exercised to have the seed fresh when planting. It may be tested by planting a small quantity in soil in a flower pot or box and keeping them warm and moist till they germinate. By keeping an account of the number that are planted and the number that sprout, a good estimate can be made of the percent of good seed and the thickness that they should be planted in the field. A good deal of information about the age and vitality of the seed can be obtained by splitting a few open and closely examining the seed and the hull. A seed should fill its case or covering and should be fresh and plump when cut open. If they do not fill these three conditions they should be thoroughly tested before planting. In some kinds like the locusts the good seed will sink and the bad seed will float in water. In case of nuts the fresh ones can usually be distinguished by the bright, fresh appearance of the hulls.

Seeds that have thick, woody, or bony coverings require more time to germinate than those that have weak, thin, absorbent coverings. Those with thick shells that have been kept moist and subjected to frost during the winter will usually germinate well without being soaked before planting. Cracking the shell with the hammer or nut cracker is not advisable as there will be more seeds injured than helped in the operation. If they have been well stored and are strong, those with thin coverings should germinate in ten days to two weeks and those with hard shells should germinate in two to three weeks, depending on the kind of seed, its vitality and the conditions of the soil.

Scalding and soaking in lye water will hasten the germination of seed that has not been well stored. If scalding is attempted, care must be exercised to avoid cooking the seed. If a small quantity of boiling water is poured over a large quantity of thick shelled seed the temperature of the water will be reduced to such an extent that no harm will be done. It is a better plan to use warm water and a little more time and be sure that no harm is done. If the seed has been properly stored during the winter and is in good condition, special treatment should be avoided as it is liable to do more harm than good. The seed of the red cedar does not germinate well until the second spring and it is not a good plan to attempt to germinate it before that time.

Nuts and large seed that require storing over winter in moist soil may be planted in the fall in well drained land. Moles, gophers and other field rodents will usually destroy some seed and in extreme cases will destroy most of it. Seeds that are stored in moist soil during the winter should be planted before growth begins in the spring and should not be taken from the soil in which they are stored and allowed to dry before they are planted. If they are dried very much at this time it will weaken them and frequently destroy their vitality. Seeds with thin covering that do not require special treatment to soften the shell should be planted about the same time that other crops are planted in the spring.

Tree seed should be planted and treated about like garden seeds in all respects. The soil should be well prepared and in such condition that cultivation can be carried on from the time the planting is complete. The condition of the soil, size of the seed, and time of planting all have some influence on the depth that the seed should be covered. Seeds should be planted deeper in sandy and loamy soil than in clay land. They should be drilled in rows from three to four feet apart. If the plants are to be taken from the row when one year old the seed should be about three inches apart in the row, but if the plants are to stand in the row for two or three years the seed should be drilled from six to ten inches apart in the row. The soil should be pressed firmly about the seed and the row covered with loose soil.

Seed of the slow growing kinds may be planted in beds about the same as onions and the plants transplanted to the nursery when one year old. This plan requires more labor and may necessitate hand cultivation for the first year. Seedlings that require shading from the hot sun during their first summer should always be started in beds. Many of the evergreens require this kind of treatment, and ash, box elder, elm, and red cedar can be very conveniently grown in a bed for one year and then transplanted to the nursery row.

For bed culture the soil should be enriched and placed in the best possible condition, and the very best of cultivation and care must be given to the plants during the summer. If the bed can be so located that it will be sheltered from the wind a great deal of moisture will be saved for the use of the plants. All weeds and grass should be kept out of the bed with the hoe and by hand weeding. A garden wheel hoe can be used to great advantage in a bed of seedlings.

## STARTING FROM CUTTINGS.

Many of the common forest and fruit trees can be started from cuttings with but little more effort than is required to grow them from the seed. The cottonwood and willows are easily and commonly started in this way. Plants grown from cuttings are usually larger and stronger than those grown from seed. Cuttings made from slow growing trees having hard wood, like oak and hickory, do not take root and grow as readily as cuttings made from rapid growing varieties.

The cuttings should be made from one or two year old wood, and stored in moist earth or sand during the winter. They should be cut eight to twelve inches long and the butts laid togther as this will save time in the spring when the cuttings will endure but little exposure.

If a large number of cuttings are set they should be set in rows about three and one half feet apart and six inches apart in the row. The cuttings are set butt end down with about two inches of the top above ground. The soil should be prepared the same as for a good seed bed. Furrows for the rows are thrown out with a turning plow and the cuttings laid along the side of the furrow in a slanting position or stood perpendicular and the soil thrown in and firmed about the base of the cuttings by tramping. The cuttings can be set more rapidly and the soil firmed about them better when they are set slanting and as this form of setting seems to have no bad features it is usually employed. Cutting may be set with a spade as follows: Sink the spade into the soil and pry it forward to open the soil. Set one or two cuttings into this opening and withdraw the spade, and firm the soil by tramping. This is a slow process and is used only when a few cuttings are set at a time. In very mellow or sandy soil the cuttings may be pushed into the ground and the soil pressed about it by tramping. These methods can be modified to suit the convenience of the planter but whatever method is used the soil must be pressed close about the base of the cutting.

## CULTIVATION IN NURSERY.

The cultivation given while the plants are in the nursery should be shallow, and frequent enough to keep the ground free from weeds and the surface well pulverized. Frequent, shallow cultivation will do a great deal to prevent the loss of water from the soil by evaporation from the surface. The cultivation should be continued from early spring till the growth has stopped in the fall. The ordinary corn cultivators are good tools to use for this work.

The faster growing trees should be transplanted from the nursery row to their permanent positions when one year old. The slower growing kinds may be planted thick in the nursery and at the end of the first year transplanted to new rows and given more room and when two or three years old transplanted to their permanent positions. Trees two or three feet high are sufficiently large to transplant to their permanent position in the wind-break or wood lot. The nut bearing trees and the evergreens may be transplanted while much smaller. The trees will grow more rapidly after they are transplanted than while in the nursery row and the work of transplanting can be done with less expense while the trees are small.

If the trees cannot be transfered direct from the nursery to the field they should be heeled-in in good shape to keep them in good condition. If the soil is dry the roots of the plants should be puddled in thin mud before they are heeled-in. A good method of heeling-in trees is to dig a trench or bed about a foot deep. Distribute the trees along one side of this and cover the roots well with damp soil. Place another layer of trees against the soil covering the last layer and cover the roots as before. Continue this process till all the plants are heeled-in. Care must be exercised to cover the roots well and work the soil in around the plants.

## PREPARATION OF THE LAND AND TRANSPLANTING THE TREES.

The land for the permanent planting should be prepared the same as for orchard planting. The trees will grow better if the land has been in cultivation for a few years and is in a good state of cultivation. The land should be stirred deep with the turning plow and harrowed down smooth before the trees are set. The land should be free from weeds and grass for after the trees are set it will be more difficult to destroy such pests. If the top soil is shallow and is underlaid with a clay subsoil the land may well be subsoiled when plowed. The subsoil thrown up by the subsoiler should fall back into the furrow and be covered by the plow and not brought directly to the surface. The same system of cultivation advised for the nursery should be followed in the permanent planting.

In transplanting the trees should be set the same depth or a little deeper than they stood in the nursery row. The roots should spread in their natural position and damp soil should be pressed firmly about the roots and trunk of the tree. It is a good plan to shake the tree while the soil is being thrown in around it to make sure that there are no open spaces under the roots. It requires but a little time to work the soil in well around the roots and yet this very important point is very frequently neglected and causes the death of the tree.

The roots are unavoidably pruned when the trees are dug and usually require no further attention in that direction. The tops should be cut back when the trees are set or soon after that time. Some of the kinds that are inclined to fork and branch like the soft maple, catalpa, and black walnut may be allowed to grow for a year in their permanent positions and then the tops cut back to the ground. Trees treated in this way grow better trunks and better tops than those that are allowed to continue the growth of the original top. Repeated cutting back will cause the trees to sprout badly at the base. All sprouts and suckers should be removed while young and tender.

### SEASON OF TRANSPLANTING.

Fall and spring setting each have their advantages and their corresponding disadvantages. Trees set in the fall have the advantage of any root growth that may take place in the winter. The soil will settle around the roots in the winter and be in better condition for growth in the spring. More time can be given to the work if the trees are set in the fall and early winter and the trees will usually be in better condition to pass the winter if planted than if heeled-in. Spring setting gives more time for the preparation of the land for the setting. Plants heeled-in can be better protected from the rabits and mice than trees set in the fall. Good results can be obtained by either fall or spring setting if the work is well done and the ground is in good condition for the work. More depends upon the weather than upon the season in which the work is done. If there is plenty of rain in the fall to put the ground in good condition for the work the trees should be set in the fall. If there is not sufficient rain in the fall to prepare the land for the trees, planting should be postponed till spring or until enough rain has fallen to prepare the land for the work. There are many warm spells during the winter in which this work can be done.

### WIND-BREAKS.

The most disagreeable feature of the climate of Oklahoma and the neighboring states is the great amount of hard wind. A planting of trees around the house and farm yards does much to diminish the effect of the wind and increase the comforts of farm life. Such plantings may also be of great value in providing shelter for stock. The comforts and conveniences created about the farm home by a good wind-break are so commonly recognized that no attempt will be made to point them out here. In fact the benefits so derived are so commonly appreciated that a great many farmers plant their orchards so they will serve the double purpose of an orchard and a wind-break and their greatest value often lies in the latter office.

The orchard will fill its place in the economy of the farm as an orchard if well cared for and should not be used permanently for a wind-break. There are few of the fruit trees that are sufficiently hardy to make a good wind-break and endure the exposure to which they are there subjected and still bear even a fair crop of fruit. It is a far better plan to set the orchard in a block form and plant rapid growing forest trees for a wind-break. The orchard will be greatly benefitted if it is protected from the southwest wind by a belt of timber. A dry wind blowing across a field dries the surface of the soil very rapidly and carries away a great deal of soil moisture. A wind-break checks the force of the wind and in this way saves a great deal of moisture for the crop that is on the land. A wind-break formed of trees draws large quantities of water from the land on which it grows but this loss is more than offset by the amount of water saved in the adjacent field or orchard.

Orchard trees sheltered by a wind-break or shelter belt of timber grow in much better form and are not leaned to the north by the wind. The trunk of the tree will be better shaded by the top and thus many cases of sun-scald and borers will be avoided. Pruning may counteract the effect of the wind to some extent but a good wind-break is far more effectual. Trees sheltered by a belt of timber or a grove are not broken like those more exposed, and carry a greater percent of their fruit to maturity. It is not an uncommon experience for three-fourths of the fruit to be shaken from the tree before it is mature. The codlin moth is the cause of a great deal of the windfall fruit in Oklahoma but the hard wind has about as much immature fruit to its credit. A good wind-break will reduce the amount of windfall fruit and will make it possible to do better work in spraying and thus check the ravages of insects and diseases on the fruit and foilage. Good spraying cannot be done in a hard wind.

Some fruit growers object to a wind-break for an orchard on the ground that it is a harbor and breeding ground for insects and diseases, and that the row of trees next to the wind-break suffers for the water which has been drawn from the soil and used by the trees forming the wind-break. If the wind-break is a harbor and breeding ground for insects and diseases it is a fault of the care and cultivation given it. It should be cultivated and cared for the same as the orchard and any insects and diseases injurious to the orchard should be combatted the same as in the orchard. The insects and diseases that are most common in the orchard seldom attack the kind of trees used for the wind-break, and the reverse is also true. If the wind-break robs the outside row of trees of food and water it is a fault in its location. A space of thirty to forty feet should be left between the wind-break and the first row of fruit trees.

The ideal wind-break is a belt of timber or a grove of trees taller than the trees in the orchard. Such a shelter belt cannot always be grown on the average prairie farm and a hedge or at best a narrow belt of timber may answer the purpose. If possible, this planting should be completed two or three years before the orchard is set, so the young fruit trees may be protected from the hard wind when they are first set in the orchard. The trees that are to form the wind-break may be set in the form of a hedge, or far enough apart in the row so they can develop and make good trees. Both plans are good and make good wind-breaks when suitable kinds of trees are used. The amount of land that can be devoted to this purpose should be the principal point in deciding the formation of the planting. The hedge row form of wind-break requires a plant with a thick growing top like the russian mulberry, and osage orange. Seedling peach trees are some times used to good advantage for this purpose. The plants should be set about one to two feet apart, and should be well cultivated to encourage as great a growth as possible. These trees make a very dense top when in full leaf and the Russian mulberry and osage orange are not commonly attacked by diseases and insects that live upon orchard trees and fruits. The Russian mulberry is the best tree, commonly grown in Oklahoma, for such purposes.

If there is room for a more extensive planting it is a better plan to set the trees four or five feet apart in rows four feet apart. In this form of planting the trees can be cultivated for a few years and made to supply posts and wood for use on the farm. The outside row of trees should be left unpruned or some low, spreading kind of tree should be planted with the tall growing varieties. The tall growing trees if pruned to grow good posts and poles will not make a good low wind-break. If the two outside rows are not pruned they will make sufficient undergrowth. The Russian mulberry and tamarisk are two of the best low spreading trees to use in a mixed planting of this kind. Seedling peach trees are some times used for this purpose to good effect. Elm, catalpa, soft maple, and black locust are the best of the tall growing trees used for a wind-break in Oklahoma.

A few farmers are growing good wind-breaks composed of cottonwood, black locust, and plum trees. The cottonwoods are planted twelve to sixteen feet apart and two or three black locusts between. The plums are planted in another row outside the row of larger trees. Either the wild plums or some cultivated varieties can be used. This combination can seldom be used successfully on upland. On loam and clay lands the black locust, soft maple, elm, catalpa, and Russian mulberry should be used. The black locust and Russian mulberry make a very good combination. The soft maple is not adapted to close mixed planting and when it is so planted provision should be made for its removal in a few years. The other trees named may be planted in mixed or pure plantings and will usually give good results.

### PLANTING FOR A WOOD LOT.

A wood lot is a planting of trees for the purpose of growing wood. The aim of the planter is to grow the most wood possible in such form, and size that it can be used for fencing and fuel, with the least expenditure of time, money, and labor. Inasmuch as the trees are expected to produce wood of marketable size within the life time of the planter, only the fastest growing trees can be used. In this climate the time required to grow trees to post size can be greatly reduced by care and cultivation, during the early life of the planting. Usually the only money expended in growing a few acres of timber is the original cost of the seed, or seedlings and the taxes on the land. The amount of time required to grow wood of valuable size makes it desirable to use all reasonable efforts to increase the rate of growth. The first thing of importance is the quality of soil on which the planting is made. Good soil is most valuable for wood production as well as for the common farm crops. Small nooks and patches in creek bottoms that are difficult to tend in the regular farm crops answer for wood lots very well. Hillsides, washed land, knolls and waste land too poor to cultivate in farm crops should not be planted with trees with the hope of securing good timber in a few years. The dry summers and the extreme barrenness of some such land places wood production thereon practically out of the question. It would require more than the ordinary lifetime for trees set on such land to bring the fertility up to the standard required to produce good wood growth. Stony land that cannot be cultivated but contains a fair quality of soil will grow good timber.

Trees grown for wood should produce long trunks free from branches. There are two ways of growing such trees; 1st constantly pruning off the branches, and 2nd planting the trees close together so that after four or five years the trees will prune themselves. The latter method is used in wood lot planting. In close planting the growth of the top is augmented and the growth of the side branches is checked, and after a few years no pruning is necessary.

Trees set far enough apart to give plenty of room for cultivation will require pruning for a long time. The tops cannot shade the ground sufficiently to prevent the growth of weeds and grass, and the annual mulch of leaves and twigs will not be heavy enough to produce a forest soil. The best results have been obtained by setting the trees four or five feet apart each way. The trees are pruned as long as cultivation is continued which should be until the trees have possession of the land to the exclusion of other plants. When the trees can shade the ground well enough to prevent the undergrowth of weeds and grass, cultivation may be discontinued. Trees with small or pendant leaves like the black locust and cottonwood cast a poor shade and are slow to prevent the undergrowth of weeds; these varieties should be cultivated until they are quite large. The broad-leaved trees like the elm cast a good shade and will prevent the undergrowth of weeds in three or four years and then are able to take care of themselves. Mixed planting does not give as good results as the foregoing would seem to indicate. There is so great a difference in the hardiness and rate of growth of the different kinds of trees set, that a mixed planting soon becomes a pure planting or at most contains but two or three of the strongest varieties. The few stunted trees of the weaker varieties that do survive for a few years seldom make good trees when the larger trees are cut. The varieties of trees most commonly grown for posts and fuel are capable of reproduction by sprouts from the stump and roots, and this crop of second growth trees will be better than the old stunted trees.

The trees that are set in the wood lot on the farm are not set for the purpose of growing timber for lumber, and all the trees will be cut before they are large enough for saw logs and many will be cut as soon as they are large enough to make good posts. The trees of the fastest growing varieties will be young when cut and will sprout well, if the cutting is done in the winter. The stumps should be cut with a smooth, sloping surface to prevent rot as much as possible. Post timber should be cut in the winter and seasoned thoroughly before it is placed in the ground.

## TREE PLANTING AT THE EXPERIMENT STATION.

The first planting of trees for the purpose of a wood lot on the experiment station farm was made in the spring of 1898. This planting consisted of three plats designated as numbers 35, 36, and 37. Trees one year old were used except in the oaks, walnuts, and pecans and seeds of these trees were planted in the position in which the trees were desired in the planting. The trees were placed four feet apart each way and were given clean cultivation for the first three years.

Plat No. 35 contained 1599 catalpas, 270 black cherries, 270 bur oaks, and vacant places were left for 1599 Russian mulberries, which were never planted. In December 1903 there were 1538 catalpas, 188 black cherries, and 142 bur oaks living.

Plat No. 36 contained 1500 white elms, 1500 soft maples, 600 bur and red oaks, and 330 black locusts. In December 1903, 329 black locusts and 260 oaks were living. Part of the elms were taken out but less than one percent have died in the plat. Part of the maples were also removed and all of those left in the plat are now dead. Seventy five per cent of the dead maple trees were infested with flat headed apple tree borers at the time of their death.

Plat No. 37 contained 2558 red maples, 511 black birches, 374 pecans, and 320 white ash. In December 1903 there were 310 white ash, 76 pecan and 126 black walnut trees living. The black birch trees were all dead, root and branch. The red maple trees are all dead but about one half of the stumps are still alive and sent up sprouts last summer. These sprouts are very weak and practically worthless.

In the spring of 1900 another planting of forest trees was made, consisting of thirty four plats. The trees used in this planting were white ash, box elder, catalpa, white elm, black locust, honey locust, and soft maple. Plat 1 to 24 inclusive and plat 27 are mixed plantings containing from three to seven kinds of trees systematically arranged. Plats 25, 26, and 28 to 34 inclusive are pure plantings. All the trees were seedlings of one season's growth when set. The black locust is the only tree that has made a better growth in the mixed plantings than in the pure planting. It is much the fastest growing tree in the list and in every case has proved an injury to the trees set next to it. This planting is not old enough to show final results and may be reported upon at some future time. All of the information that could be obtained from this planting at this time is given in the discussion of the different kinds of trees.

*Ash*: (White Ash, American White Ash.) This tree is valued more for its beauty of form and foliage than for its wood production. It attains a height of fifty feet and a trunk diameter of two feet. It grows very slowly for the first four or five years after which time it grows more rapidly. The top of the tree is narrow, with a main central stem forming a clean straight trunk. The wood is heavy, hard, strong, and becomes brittle with age. It is not durable when placed in contact with the ground but is a very good fuel.

*Box Elder*: The box elder grown on moist bottom land often attains a height of forty to fifty feet and a trunk diameter of two feet. In this situation it is a rapid growing tree with a broad top and casts a good shade. It is a failure when planted on the upland. It is frequently attacked by borers and leaf eating insects. The wood is light, soft, not strong, rots quickly in contact with the ground, and is a very poor fuel.

*Catalpa.* The catalpa is a rapid growing tree, often attaining a height of sixty feet and a trunk diameter of three to four feet. It grows best on a deep rich soil and a satisfactory growth can seldom be secured on light, thin soil. In a pure planting the trees will completely shade the ground in three or four years. It sprouts well from the stump when the trees are cut in the winter. The wood is light, soft, not strong, coarse grained, and extremely durable when placed in contact with the ground. It is poor fuel but makes first class posts and fencing material.

There are two species of Catalpa, *Catalpa speciosa,* commonly called Hardy, or Western Catalpa, and *Catalpa Catalpa,* commonly called Southern Catalpa. The Western catalpa is a tall upright tree with few large branches. It requires close planting to develop a good trunk. The Southern catalpa is a low growing tree with a broad top. These characteristics are influenced by soil and location. On poor soil in open plantings both kinds form low, branching heads. The Western catalpa as a rule produces only one to three seed pods in a cluster, and each pod is from fourteen to twenty inches long and one half inch in diameter. The seeds are large, broad, and about the same width the entire length. The filaments at the end of the seed are parallel or spreading. The bark of tree is thick and deeply furrowed. The Southern catalpa produces from four to eight pods in a cluster, and each pod is from eight to ten inches long. The seeds are small and tapering at the end. The filaments are drawn together and are sometimes twisted. The young branches of one season's growth are enlarged at the joints. The bark of the tree is thin and scales off in large thin scales.

*White Elm* (American Elm.) This is a large tree and when full grown often attains a height of one hundred feet and a trunk diameter of six feet. It forms a round or broad and spreading top. It is a rapid grower and adapts itself well to all kinds of soils. The wood is hard, heavy, strong, tough, difficult to split, not durable in contact with the soil. It makes a good fuel when it is reduced to such form and size that it can be used, but is very difficult to work. This is the best shade tree that has been planted in Oklahoma. The tree is hardy, seldom attacked by insects and diseases and casts an ideal shade. It is a first class tree to plant about the house and yard but is only a second class tree for posts and fuel.

*Hackberry.* The Hackberry attains a height of sixty to seventy five feet and a trunk diameter of three to four feet. When planted in good soil and given cultivation it is a rapid growing tree but is capable of living when set in the driest and poorest soil. As a cultivated tree it is very much like the elm but it more hardy and the wood is less difficult to split. The wood is heavy, rather soft, not strong, good fuel, not durable when placed in contact with the soil. It is a good tree for planting around the house and yard and for a wind-break.

*Black Locust,* (Yellow Locust.) This tree grows rapidly and attains a height of sixty feet and a trunk diameter of three feet. The top is of good form with a main central stem when grown in close plantings, but it frequently branches and forms a large round head when grown in the open. It grows fastest when set in mixed plantings but does not form as good a trunk. It usually grows more rapidly than the other trees and branches and spreads over the tops of the other trees. It casts a poor shade and is slow to occupy the ground to the exclusion of other plants. It sprouts vigorously from the stump and roots broken by the plow or spade. The wood is heavy, exceedingly hard, strong, and durable when placed in contact with the ground. It is a very good fuel.

This tree has been extensively planted as a timber tree in the United States, but its cultivation is now generally abandoned in the older states on account of the locust-borer. The locust-borer has been so destructive of this tree in Kansas that it is not planted there now to any great extent. The central and western part of the state was at one time supposed to be exempt from the borers but they have gradually spread over the entire state. So far as can be learned this borer has not appeared in Oklahoma, but it is only a question of a few years till it will be found in abundance. Although thorough search has been made no reports have been found which indicate that the locust borer ever works on fruit trees.

*Honey Locust.* This tree attains a height of fifty to sixty feet with a trunk diameter of three feet. It is not one of the most rapid growers but is capable of making a good growth under the most adverse conditions. It is liable to suffer when transplanted and should be carefully handled at that time. It stands pruning remarkably well and is often used as a hedge plant. It casts a poor shade and is slow to occupy the ground to the exclusion of other plants. It requires thick planting to form good trunks. The wood is heavy, hard, strong, very durable in contact with the ground and is a good fuel.

*Soft Maple.* (Silver Maple.) This tree often attains a height of sixty feet and a trunk diameter of four feet, but the mature trees are usually much smaller. It grows rapidly and forms a broad, round top. This tree responds very quickly to cultivation and suffers if neglected. In close planting it grows rapidly for a few years and then dies out badly. The trees suffer if the roots are exposed to any extent in transplanting. Winter and spring setting have given the best results. The trees are frequently destroyed by borers and the foliage is attacked by insects and fungus diseases. The wood is soft and easily broken while green but becomes hard and strong when well seasoned. It is light, poor fuel, and rots quickly when placed in contact with the ground.

The value of this tree has been over estimated in Oklahoma and it has been planted more than its true value warrants.

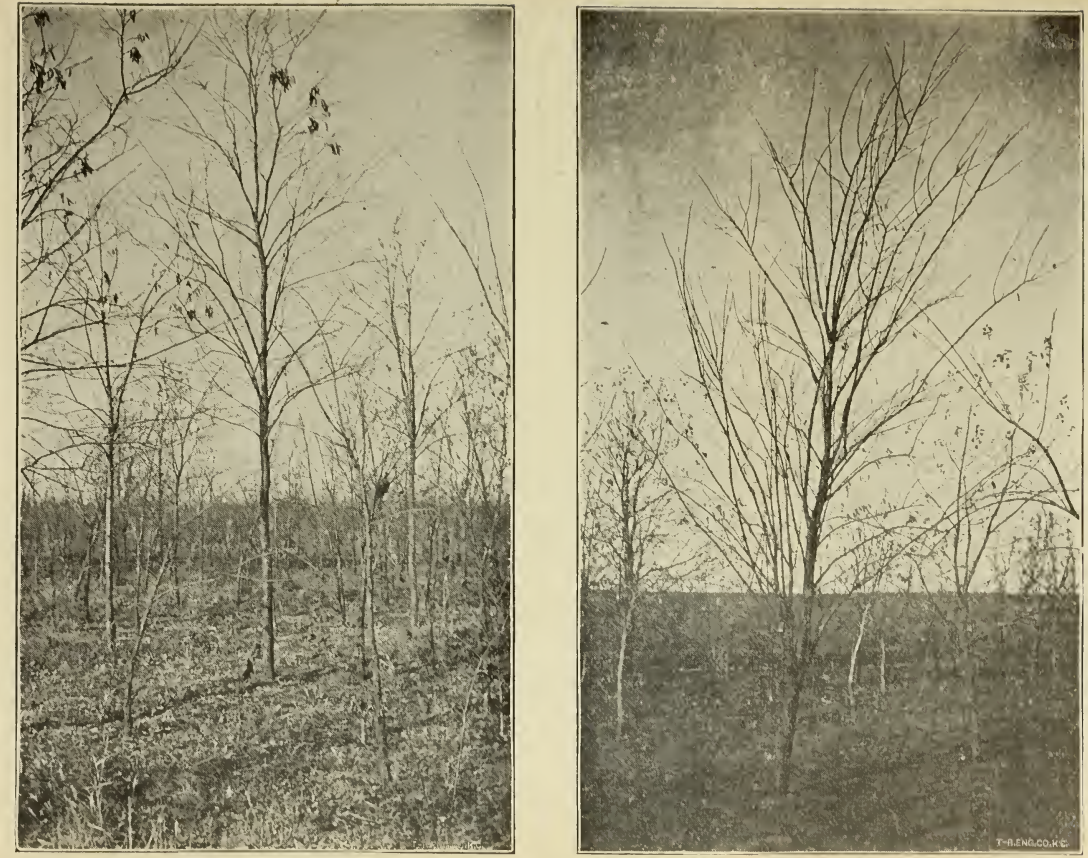
*Osage Orange.* (Bois d' Arc.) This tree attains a height of forty to fifty feet and a trunk diameter of eighteen inches. It is a rapid grower on moist bottom land but is not adapted to light, upland soil. It sprouts vigorously from the stump and broken roots. The wood is heavy, hard, strong, flexible, good fuel, and very durable in contact with the ground.

*The Russian Mulberry* is a medium sized tree introduced into the United States from Russia and it is not known how large it will grow in Oklahoma. Trees fifteen years old and twenty feet high are not uncommon. The tree branches profusely and forms a very dense top and a poor trunk unless it is constantly pruned. It is very hardy, grows rapidly and is a first class tree for a wind-break. The wood is heavy, hard, strong, and is a good fuel. Its durability in contact with the ground has not been thoroughly tested but the indications are that it is as durable as the Red Cedar.

*Sycamore.* This is the largest tree east of the Rocky Mountains. It often attains a height of one hundred feet and a trunk diameter of ten feet. It grows rapidly and forms a good top. It is a very good tree for ornamental planting. The wood is of little value and hard to work.

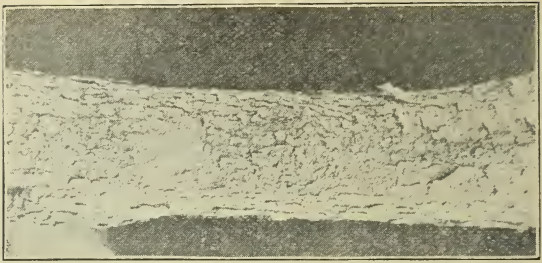
*Black Walnut.* This is a very large tree sometimes attaining a height of one hundred feet, and a trunk diameter of eight feet. It is of slow growth and is adapted to planting only on rich bottom land. It is difficult to transplant. The wood is heavy, hard, strong, easily worked, and durable in contact with the ground. It is good fuel but is too valuable to use for that purpose.

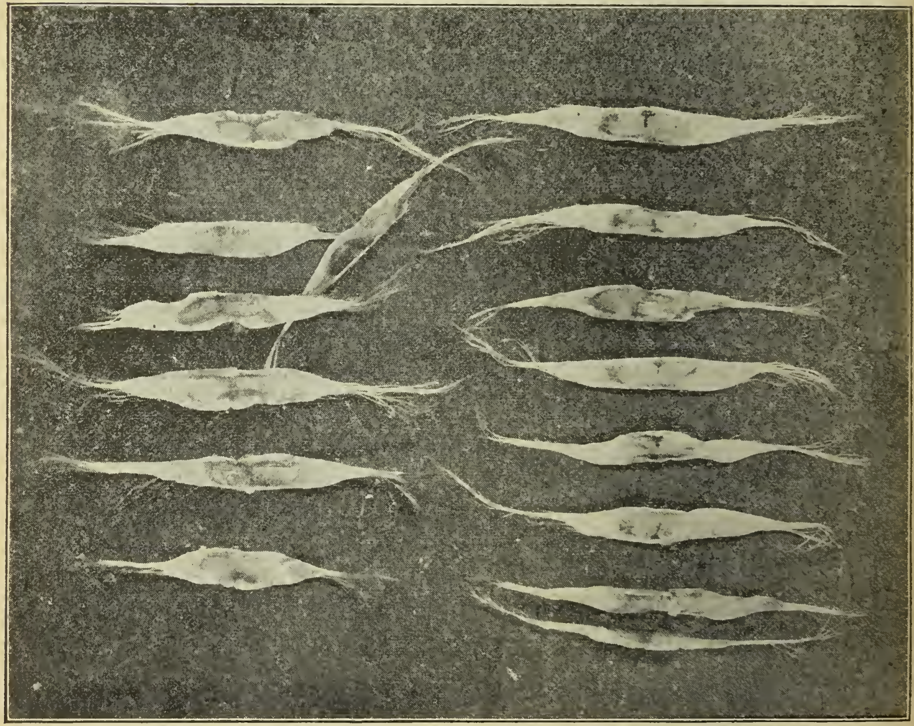
O. M. MORRIS,
Horticulturist.



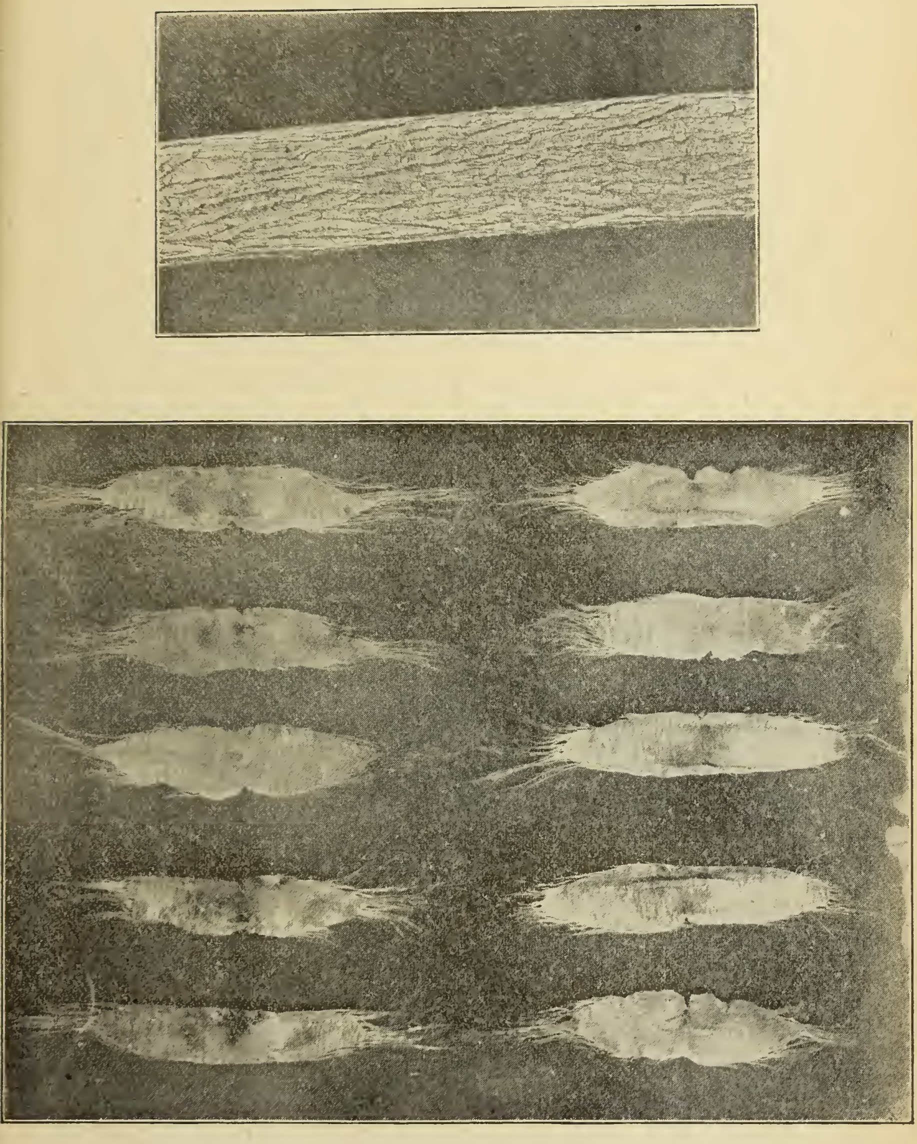
Thick Planting. Thin Planting.

BLACK LOCUSTS.





Character of bark and seeds of Southern Catalpa. (Cut of seeds from Kansas Station.)



Character of bark and seeds of hardy or Western Catalpa.
(Cut of seeds from Kansas Station.)

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# Oklahoma Agricultural Experiment Station,

STILLWATER, OKLAHOMA.

BULLETIN NO. 61, JANUARY, 1904.

## FIELD EXPERIMENTS.

### SUGAR BEETS AND MANGELS.

These crops have been grown on the station farm, more or less irregularly, since the opening of the work here in 1892. In 1897, experiments were taken up in co-operation with the U. S. Department of Agriculture to study the adaptability of Oklahoma soils and conditions for growing sugar beets for sugar production. The results of this work have been reported elsewhere in the station publications. While the results gave very little encouragement to those wishing to boom the beet sugar industry in Oklahoma, they indicated that growing beets as a stock food might prove very profitable.

In Oklahoma, with its very open winters that generally afford a growth of wheat through the winter months that makes a pasture not excelled by a pasture of Kentucky blue grass in June, the need of succulent feed such as silage and root crops is not felt as it is in the northern states when everything is frozen up for three or four months of the year. But there are times during almost every season in Oklahoma when the wheat pasture is not available and a few pounds of mangels to furnish succulency to the ration of dry feed would greatly stimulate the appetite and digestion and aid in keeping animals in a vigorous, healthy condition. These root crops are particularly valuable as an addition to the ration of breeding and growing stock and dairy cattle. The pregnant cow, mare, sow, or ewe needs some food of this nature and very frequently wheat pasture is not available or convenient to use. At time of breeding, if a portion of the ration is a succulent feed, little trouble will be experienced in getting animals to "catch." In Oklahoma, sugar beets or mangels are available from the first of September to at least the last of May, where they are stored properly. They should be fed as only a portion of the ration, eight to fifteen pounds per day for a cow, although much more might be fed if they were plentiful and cheap and the only source of succulent feed.

For stock feeding, mangels, or stock beets, as they are called, fill the place of sugar beets very well. The mangels contain less food material per hundred pounds than the sugar beets but the mangels generally yield considerably more per acre, and are generally considered more easily raised than the sugar beets.

In the spring of 1900 a plan was formulated to obtain the comparative yields of sugar beets and mangels on the station farm and to ascertain the practicability of growing these crops for stock food in Oklahoma. For a series of years, good sized patches of some of the standard varieties of mangels and sugar beets are to be grown.

## RESULTS IN 1900.

The crop was situated in a field where the soil is of a stiff heavy nature underlaid with a gumbo subsoil. The field received an application of barnyard manure several years previous to this cropping.

The soil was prepared by plowing in March and floating and tho ough harrowing. The seeding was done on April 16th with a one-hors drill. The seed was put on very liberally in rows thirty inches apart, the seed being covered about one inch deep. Two varieties of sugar beets, White Improved and Kleinwanzlebener, and two varieties of mangels, Eiffel Tower and Golden Tankard, were planted with seed purchased that season, but the seed was not soaked before planting and the stand obtained was so very poor that the plats were disked up and seeded to other crops. At the time of the other seeding a fifth plat was seeded to sugar beets of an unknown variety, the seed having been on hand for a year or two and the label lost. As the seed was old, it was soaked fc over twenty-four hours, and a perfect stand was the result. The to soil was a little dry at the time of seeding.

The sugar beets on this plat were up May 3rd and were cultivated with a hand plow May 4th. May 9th, the plat was cultivated crosswise with a Hallock weeder. After this treatment the plants were thinned to a stand six to ten inches apart. May 14th, cultivated with hand plow. June 2, cultivated with horse cultivator. July 19th, cultivated. July 31, plowed with cotton sweep to throw dirt to beets. The harvesting was done the last week in November and the beets were pulled and stored in a long rick, then covered with straw and dirt, the details of which will be given later. The beets were loosened by running a furrow close to each side of the row with a cultivator shovel drawn by a horse. After treating in this manner, they were easily pulled by hand and the tops twisted off before they were thrown down. This plat contained a little over an acre and produced at the rate of 9.81 tons of beets per acre.

### RESULTS IN 1901.

The plats were situated in the same field as in 1900, but were in a different portion of the field. The crop was drilled on April 13th in rows thirty inches apart. The plants were well above ground by the last of the month and a very fair stand was obtained. Mammoth Long Red, and Golden Tankard mangels and White Improved sugar beets were planted. The plants were thinned where there were two or more in a place. The crop was kept clean by frequent cultivation during the season and the growth was very fair. The total crop harvested the latter part of November turned out 8,314 pounds. The yields of the individual plats per acre cannot be given as the measurements of the plats were lost, but the crop was considered a good average.

### RESULTS IN 1902.

During the season of 1902 this experiment was caried out on soil similar in character to that described under the 1900 experiment. It would be designated as loam surface with a heavy, impervious subsoil. The portion of the field on which these roots were grown had been manured several years previous with barnyard manure. The field was plowed in January to a depth of eight or nine inches, and then harrowed. The soil was harrowed twice prior to seeding.

The seed was sown on the 9th of April with a shoe drill in rows thirty inches apart. The soil was in good condition at time of planting and contained sufficient moisture to germinate seed rapidly. On April 24th most of the plants were up and the plats were cultivated two days later. The soil was again stirred on May 10th with a five-toothed hand cultivator. After beets had been growing for one month they were thinned out to a stand of one plant to every six inches and surplus plants were used to fill up deficiencies in rows. The major portion of plants that were reset lived and this aided to quite an extent in filling out vacant places and insuring a uniform stand. The plats were cultivated with spring-tooth cultivator on May 27th and again on June 30th. During the growing season it was necessary to go over ground twice with hoes in order to cut out the few weeds which the cultivator had missed.

The month of August being comparatively dry, the roots did not make a normal growth and at the beginning of September they were very small. From September 20th to October 1st several heavy showers fell and the soil became thoroughly moistened. Fine weather followed during the month of October and the beets grew rapidly until time of harvesting.

The rainfall during November was excessively high and owing to the fact that the soil was very wet, harvesting did not commence until December 1st. The weather turned cold December 3 and the soil was frozen to such an extent that it was impossible to finish taking out roots. The Mammoth Long Red mangels suffered the most from this freeze, due to the fact that they grow in large part above the surface. The White Kleinwanzlebener variety was not damaged very much, as these beets grow quite deeply in the soil and they have a very heavy top, which afforded some protection.

Three varieties were grown this season and the yields are as follows: Mammoth Long Red, 17.5 tons per acre; White Kleinwanzlebener, 14.1 tons per acre; Golden Tankard, 13.3 tons per acre.

## RESULTS IN 1903.

The plats this year were located on the same field as last year but on another portion of it. The soil is quite similar in character over the entire field but the portion upon which beets were grown this year has received no manure since soil was broken. This part of the field has one or two small alkali patches on it. The beets appeared to grow almost as large on these patches as on other portions of the field.

The field was plowed April 14th at a depth of seven inches and the ground was harrowed immediately. This treatment left the field in excellent condition. The planker was used to compact the surface somewhat and break any lumps that might be found.

The plats were seeded April 16 with a shoe drill in rows twenty-four inches apart, the seed being placed in soil about one inch deep. The seed was soaked in water for about twelve hours prior to time of drilling. The water was then drained off and the seed was spread out on a floor under the direct rays of the sun and allowed to remain for two or three hours, until the surplus moisture was removed. If seed that is soaked in water is not treated in this manner, some difficulty will be encountered in getting it to pass through the feeder in the drill. Nine pounds of seed were used to seed an acre. Ten days after seeding the young plants were showing nicely, a fair stand having been obtained on all plats except one. In this latter case, the seed was distributed rather unevenly owing to fact that it was rather moist after being soaked and thus did not feed freely. The roots were thinned from May 28th to June 4th to a stand of one plant per six inches. The work should have been done at an earlier date, for the plants were quite large at that time, but heavy rains during the month kept the soil wet and unfavorable for thinning. The surplus plants were used to fill up vacant spaces in the plats, but unfortunately weather conditions were such that a very small percentage of the transplanted plants lived. A few warm sunny days that followed the cool weather of May cooked the plants which were transplanted.

The plats were cultivated on June 8th with a single horse cultivator. Three days later the weeder was used. This machine stirred the soil around the small plants and covered up a large number of small weeds which could not be reached by a larger cultivator. The three plats were given three cultivations, June 29th, July 7th, and July 15th, with a single horse cultivator. The patch was hoed out twice during the season.

The season as a whole was favorable to the growth of the crop. The soil dried out quite a little in August, but subsequent showers were of sufficient duration to moisten the soil thoroughly. The White Kleinwanzlebener variety was damaged to some extent with leaf spot. The Golden Tankard variety was also affected to a slight degree.

Three varieties were used in the experiments and the yields are as follows: Golden Tankard, 13 tons per acre; White Kleinwanzlebener, 7.27 tons per acre; Long Red Mangel, 7.2 tons per acre. The crop was harvested November 9th to 13th.

## SUMMARY.

For the two years, the Golden Tankard mangel gave a slightly larger yield than the Long Red mangel. The sugar beet was not far behind the mangels in yields. It is a very difficult matter to get an accurate yield test as the stands vary so much from year to year. The Golden Tankard mangel is probably the best known and most extensively grown, although the Long Red mangel under different names is largely grown. Beet seed usually costs from twenty-five to forty cents per pound. Great care should be exercised in buying seed as much worthless stuff is sold. These root crops grown on the station farm have been utilized as feed for all kinds of stock and although we have abundance of wheat pasture during the winter, we consider them a profitable and indispensable article in the rations.

## GENERAL SUGGESTIONS.

It may be stated in a general way that any soil that will produce corn, wheat and oats will yield a paying crop of these roots. The best yields are obtained on deep, mellow soils of an open nature. Where the soils are of a heavy character and the subsoil a stiff clay, subsoiling will increase the yields and should be practiced when possible, but subsoiling is not necessary in order to produce paying yields on such soils, and rather than to pass the crop by if subsoiling cannot be done, it should be seeded without subsoiling. If the beets are grown for sugar production, subsoiling is considered necessary on heavy soils. Good deep plowing, eight to ten inches deep, is feasible and should be practiced for these crops and it should be done during the winter or early spring. If heavy rains have run the soil together before seeding the ground should be replowed. At all times a fine, mellow seed bed should be prepared by frequent harrowings before the seed is planted. A rolling or floating very often aids much in getting the seed bed in shape.

In order to lessen the cost of cultivation a clean piece of land should be selected to plant on. Beets on foul land are a very expensive crop. Early seeding is by far the most desirable, and in Oklahoma, this means early in April, although beets planted in May have made a fair crop this far south. The crop should be planted in rows and cultivated. Larger yields can be obtained by having the rows as close as 18 inches but the extra expense of cultivation overbalances the lighter yield from rows farther apart. This station recommends that the rows be put far enough apart so that a two horse cultivator can be readily used, and for this the rows should be 30 inches apart. If a regular beet drill is not available, a cotton or a corn drill may be used with a little fixing, but the best drill to use is a wheat drill. The seed should not be put in until they can go into moist soil and to obtain this condition they may be covered to a depth of one and a half inches. Half an inch is deep enough if the soil is in good condition and the weather favorable.

Getting a stand is one of the most difficult factors in beet culture and one of the greatest drawbacks to the crop. Most of the seed used in this country is imported from Europe and before much of it reaches the hands of the farmer, it has lost its vitality and much of it contains trash. The seed as purchased is made up of pods, each one generally containing from two to three seeds, and it apears to the grower as if all of these in one pod grow or none grow and he has his plants in bunches with numerous skips between. Due to this characteristic of the seeds containing several germs in a pod and generally producing two or more plants in a place, thinning is unavoidable and is quite an expensive part of the operation. It should be done while the plants are small, after they have produced the fourth leaf, and can be accomplished only with the fingers.

The plants that are pulled out grow quite readily when transplanted and may be used to fill in the skips in the rows if help is available and is not too expensive to do the work. In this way many irregular stands may be converted into good even stands. Transplanting sugar beets where the crop is grown for sugar production is not recommended by many.

In drilling, the drill should be set so as to scatter the seed in the row thickly, a seed pod every inch is not too thick. This will require eight to ten pounds of seed per acre if the rows are about 30 inches apart.

Beet seed germinates very slowly and the process is greatly hastened and insured by soaking the seed for twenty-four hours in water just before seeding. To get them in condition for seeding after they have been soaked, take out and drain and then spread out in the wind and stir frequently until the outside is sufficiently dry, which under favorable conditions will be in a couple of hours. If anything happens to interfere with putting all the seed in at once after it has been soaked, cover it up so that it will not dry out and it will keep for several days if kept cool.

The coming up period and the first few weeks after this are the critical times with the beets. Where much rain has fallen after seeding and before the crop is up, on heavy soils, a crust forms that makes it difficult for the plants to penetrate and unless this crust is broken in some way many of the plants never come through. A hand rake or a horse weeder does this work very nicely. The plants are very small and grow slowly at first, so stirring the soil must commence before the usual methods of cultivation. If the soil is stirred between the rows with a cultivator, the soil so loosened may be distributed around the small plants with a harrow or weeder. As the plants are some time in coming up, it is well to harrow lightly about a week after the seeding. After the plants are of sufficient size, the weeds should be kept out and the surface kept mellow with the regular cultivator.

A drouth will check the growth of beets but if the soil is in good tilth they will live and when fall rains come will make much more growth before harvest time. This fall growth is allowable when the beets are for stock feeding but is considered detrimental when they are to be used for sugar production. The harvesting should be postponed until cool weather. As a rule in Oklahoma they will not be damaged by freezing in the field before the first or middle of November. In many seasons, they might remain in the field until the first of January. The tops cover them so that a light freeze does not reach them.

In this country, it is not advisable to go to the expense of making a root cellar or cave. Beets or mangels keep in perfect condition if piled in ricks and covered with straw and earth. For the past four years the following plan has been followed at this station and the beets and mangels have been preserved in fine shape. As pulled, the tops are twisted off and the roots are thrown into small piles in the field to be gathered up later with the wagon. For storage space, a plot of ground is selected where the drainage is good. A light layer of straw is spread where the beets are to be piled. The piles are generally made five or six feet at the base and run up to a peak which is about four feet from the ground. The pile is then covered with about six inches of loose straw. This is then covered with three to five inches of dirt with the exception of a space of about 8 to 10 inches wide at the top of the pile which is generally left open most of the winter, being covered with nothing but the straw. The dirt for covering is obtained by digging a trench about two feet from the edge of the beet pile. When the roots are wanted for use, one end is opened and the roots removed as needed, care being taken to cover the opening with straw each time.

These root crops will not attract the farmer who is contented to put all his land in wheat or cotton and keeps a very indifferent kind of stock if any, but the farmer who is striving to maintain the fertility of his soil by diversified cropping, and is utilizing the larger portion of these crops as feed for improved stock, should see the advantage in growing a small acreage of root crops and act accordingly.

## KAFIR CORN AND INDIAN CORN.

In many parts of Oklahoma, Kafir corn has been one of the staple crops since the opening of the country, but in other sections where it was grown quite extensively at first, particularly in the eastern portion of the Territory, the acreage has been much contracted and very little is grown in some parts now. It is doubtful if the total acreage in Oklahoma in 1903 was as much as it was five years ago. The cause of this falling off in acreage in Oklahoma cannot be definitely stated. In Kansas the acreage has steadily and rapidly increased as is shown by the last record in 1902. Since 1893 the increase in acreage in that state in the nine years has been over 400 per cent. Some have given the following reasons for the shrinking in Oklahoma. Probably it is due to the fact that the crop is not as easily and economically harvested and stored as Indian corn and for most purposes must have special preparation for feeding in order to obtain desirable results, which is not the case with Indian corn. Again, it is not as salable an article as Indian corn nor is it equal in feeding value. While it is true that Indian corn takes the lead in these respects, the difference is not great. On the other hand each succeeding year has proven Kafir corn far better able to produce grain and forage on the uplands in Oklahoma. On such land in the drouthy years, corn is a total failure while Kafir yields a fair crop of grain and stover. In the good seasons on the bottom lands, corn equals Kafir but in a drouthy season the Kafir will produce the most grain. Generally, particularly on the uplands, where the growing of Kafir has been abandoned, no grain crop is grown except wheat and a little oats, and the time will probably come again when Kafir will be much more extensively grown on these uplands.

### RECENT EXPERIMENTS.

Some of the first work started at the Oklahoma experiment station was experiments to ascertain the comparative yields of corn and Kafir corn. Results up to 1900 have been published in previous bulletins. The following results for 1900 to 1903 will afford the purpose of such comparisons although the experiments were really planned for other purposes and the plats are not quite as near together as they should be for close comparison. The results are from half-acre plats that are in some rotation and cropping experiments, the details of which will not be given here as they will be published later. In these experiments, each treatment is carried out on manured and unmanured ground.

The details of planting, cultivating, and harvesting for each year will not be given here but the following general plans were followed out: For the Kafir corn the ground was plowed in the winter or early spring and thoroughly worked down with a harrow until a fine mellow seed bed was obtained, always giving one harrowing just previous to planting. Surface planting with a wheat drill or corn or cotton drill was practiced. As a rule, the rows were made three feet apart and the seed was dropped very thick in the row to be thinned to the desired stand after the plants had obtained some size. The seeding was done the latter half of April as a rule. The first and second cultivations were made with a harrow and one of these crosswise of the rows so as to thin out the plants. After the first cultivation with the cultivator, the plants were thinned to a stand of one plant every four to six inches. Generally three cultivations with the corn cultivator were made during the season. The grain was usually ripe early in September at which time the fodder was cut and shocked and allowed to remain in this condition for at least two months. Then the heads were cut off and the grain thrashed and the fodder stacked. The black-hulled white variety was used each year.

The corn was drilled in rows three and one-half feet apart and as far as possible there was a stalk every sixteen inches in the rows. The ground was prepared by winter plowing and shallow furrows were opened up with a lister at the time of planting. The best of cultivation was given during the season.

## COMPARATIVE YIELDS.

The following table gives the yields of grain and stover per acre for the four years.

| Year. | Treatment | Kafir Corn, Yield per Acre. | | Corn. Yield per Acre. | |
|---|---|---|---|---|---|
| | | Stover Tons. | Grain Bushels | Stover Tons. | Grain Bushels |
| 1900 | Manured | 5.12 | 41.07 | 2.17 | 17.27 |
| | Unmanured | 3.51 | 31.68 | 1.63 | 18.92 |
| 1901 | Manured | 2.18 | 27.2 | ..... ...... | ........... |
| | Unmanured | 2.15 | 26.9 | .7 | 0.16 |
| 1902 | Manured | 3.1 | 32.3 | ...... ... | .... ....... |
| | Unmanured | 2.83 | 20.6 | 1.48 | 8.2 |
| 1903 | Manured | 3.57 | 35.2 | 1.25 | 37.22 |
| | Unmanured | 2.99 | 28.9 | .87 | 17.48 |
| Average | Manured | 3.49 | 33.94 | 1.71 | 27.24 |
| | Unmanured | 2.87 | 27.02 | 1.17 | 11.19 |

In 1901 the total weight of the Kafir fodder was taken on each plat and then the heads cut off and thrashed and the grain weighed but the weights of the grain were lost so that the only way to get the yield of grain and stover separate for this year was to compute the proportions of grain and stover from the total weight of crop. For the years of 1900, 1902, and 1903, 26 per cent of the total crop was grain and the 1901 yields were computed on this basis.

The yields of the Kafir corn grain as given in the table are 1-4 to1-3 below the actual amount of grain produced as the English sparrows took about this amount of the grain while it was growing. Every effort was made to keep them out of the standing crop but with poor success. After the crop was cut the shocks were covered with sacking that stopped further loss from this source.

The corn crop of 1901 was practically a total failure due to a very dry season. The season of 1902 was somewhat more favorable but a dry spell struck the corn plats in this experiment just in the critical time of silking and shooting. The corn crop of 1900 suffered considerable from drouthy conditions and the manured plots in this experiment had tillered considerably and made a rank growth which made these plats suffer more from the drouth than did the unmanured plats. Several times, severe dry spells were under way while the Kafir was heading and the grain forming.

In 1902 ten varieties of corn grown in another field yielded from three and one-half to twelve bushels per acre. In 1903 five varieties of corn grown in another field yielded from seventeen and one-half to twenty-three and one-half bushels per acre.

In 1902 the Kafir stover and corn stover was sampled for moisture determination and the former found to contain 75.8 per cent dry matter and the corn stover 80.22 per cent of dry mater.

## SUPERIORITY OF KAFIR ON UPLANDS.

Table one shows very clearly the superiority of Kafir corn over corn for producing grain and stover on heavy upland soil in the average season in Oklahoma. On the manured ground Kafir produced 51 per cent more stover and 19.7 per cent more grain than the corn. On the unmanured ground the Kafir yielded 59.2 per cent more stover and 48.5 per cent more grain. These percentages are computed on the averages for the four years.

## FEEDING VALUE.

There is little doubt left as to the comparative yield of these two crops, particularly on the uplands. It is now conceded that for cattle and hogs the feeding value of Kafir corn is about 15 per cent below that of corn. Feeding experiments at this station give about the above difference. This is when the grains are ground. The unground grain will not give nearly as good results in comparison as the ground grain. For horses and sheep, the difference in value is less and Kafir corn is considered by many to be equal to corn. For cattle, if the grain is not thrashed and ground the results will not be satisfactory and a great deal of waste will occur. Kafir stover is generally far superior to corn stover in this country. It is not in the shock as early in the fall to weather and bleach; it is harvested in a nice green condition with most of the leaves still on; it is more compact in the shock, hence suffers less damage from the weather; and a larger proportion of the stover is eaten than there is of the corn stover.

## CHARACTERISTICS OF KAFIR CORN.

To encourage better methods in raising this crop and to answer the inquiries of farmers new to the territory who are not familiar with the raising of the crop, the following summary is given: Kafir corn responds well on rich, deep soil, but its great value lies in the fact that it will produce 25 to 40 bushels of grain on stiff, heavy soil that will not produce a paying crop of corn in the average season in Oklahoma. Hence the selection of the soil is a simple matter.

Another very strong feature of the crop is its dry weather resisting qualities. It has a very vigorous, deep and extensive root system that pumps the water from a great area of soil. Again if all the moisture within reach of the plant is exhausted, the plant rests in a dormant state, which very frequently lasts for several weeks, until rain comes and then the crop takes a new start and completes its growth.

Several years ago three varieties were grown, the red, the white, and the black-hulled white. The first two have been practically abandoned for the black-hulled white. It is the only variety grown on the station farm now, as it has proven the most desirable variety. Kafir corn has greatly deteriorated in productive power on the average farm since it was introduced. This is due to the fact that no atention is paid to seed selection, as seed is taken from the general crop, where the quality is often very inferior, without making any selection. The seed should be selected before the crop is cut by choosing good, compact, long heads that are well filled at the butt and that run up to a good square top. These should be taken care of in such a manner that they will not mold before they are cured. Kafir corn is a warm weather plant and is a weak germinator, particularly in cold, wet ground. The seed is small and the early growth is much slower than that of corn. For the above reasons, in order to get a good stand a liberal supply of seed should be put on and if the stand is a little thick it may be thinned out by cross harrowing while the plants are small. For the maximum production of grain and stover the stalks should stand four to six inches apart in the row. This is best obtained by putting the seed in thick as stated above and thinning out by cross harrowing. For dry sections the stand should not be quite as close as this. The lister is sometimes used in seeding the crop but it is not a desirable way as a rule only on light open soils in the western districts. When put in this way the seed generally goes into cold ground and is in much danger of being drowned out and covered up with heavy rains and the very small, slow-growing plant at first is very hard to cultivate in the bottom of the lister row. The seed does not readily push through soil that has been washed over it. Surface planting is much more desirable as the crop can be more successfully started. The rows should be as close as the working of a two horse cultivator will permit, which is about 30 inches. The preparation of the seed bed does not differ from that for corn but particular pains should be exercised to see that it is fine and mellow as the seed is small and delicate. Again it is important to give all weeds a back-set by a good harrowing just before the seeding of the Kafir corn.

The characteristics of the seed and the early growth of the plant should be borne in mind and the seeding deferred until the soil is warm and the weather settled, and generally this will be by the middle of April in this country.

The seed can be most readily put in with a wheat drill by closing the feed spouts that are not wanted. The ordinary drill should be set to seed about 1 1-2 bushels of wheat but this should be tested for each drill. For cultivation the soil should be kept well stirred and free of weeds as possible. The work should start with one or two good harrowings, one of which should be made crosswise of the rows and the harrow so adjusted and operated that the plants will be thinned to the desired stand.

### HARVESTING.

If the crop is grown principally for the grain and little is expected of the stover, the grain may be gathered any time after two or three weeks have elapsed after the ripening of the grain. If full value is to be gotten out of the stover as well, the crop should be cut as soon as the grain ripens. Due to the fact that the leaves and stalks remain green until the grain is ripe, and usually long after this time, the harvesting is often put off for some time after the grain is ripe. After the seed ripens, the stalk and leaves deteriorate in value by becoming woody and unpalatable.

The problem of harvesting the Kafir crop has bothered a great many and probably the fact that the operation is a little more difficult than with corn and requires a little cash outlay for thrashing, has been the cause of some abandoning the growing of the crop. Several methods are used in harvesting the crop: the heads are cut off in various ways while the crop is standing; the fodder is first cut and shocked and the heads cut off later; sometimes the heads are not cut off but the whole plant is run through the thrasher, or the heads put in far enough to remove the grain and the rest of the fodder then removed. The next to the last method was never very popular and is seldom used now as it is a very expensive operation. The heads are broken or cut off by hand while the crop is standing or one of the various headers that have been made for the purpose is used. Some of these headers are complete in themselves, containing the box for holding the heads as cut mounted on wheels and arranged to be drawn by a team. Another kind that is being used very successfully on the station farm is one that is attached to the side of a wagon box and is run by a sprocket wheel on the hind wheel of the wagon. The make of this header is the Eagle, and it cuts the heads off and elevates them into the wagon as the team walks. It is an implement that should be owned by all who expect to grow Kafir corn to any extent. When the harvesting is by hand many prefer to break the heads off close to the butt and state that more bushels can be gathered in a day than can be gathered in corn husking. A jack knife can be readily used for severing the heads. If the heads are to be gathered before the fodder is cut, which has been stated should be done shortly after the grain is ripe, and if the fodder is to be saved, some precaution will have to be taken to keep the heads from moulding. This is done by putting them in small stacks with alternate layers of straw, or in small piles on the sod if the weather is favorable.

The fodder may be cut by hand, with the various sled cutters, with the grain binders, or better still, with the corn binders. If one is raising much Kafir corn, undoubtedly a corn binder will pay. Not only does it put the fodder in good shape for handling but when in bundles the heading can be done with much less trouble and expense. The heads are taken off the cut fodder by putting the tops of the bundles over a block fixed for the purpose and severing the heads with several blows of a broad ax or corn knife. Taking off the heads with a cutting or chaffing box is a very rapid and convenient way, as the bundle is placed in the box and the heads taken off with one shear of the knife without shattering any grain. The heads are very readily thrashed in the common thrasher, but this should not be done until the heads have cured several weeks after cutting, if the grain is to be stored in large quantities.

At the time of thrashing, the heads should be dry, as damp Kafir corn heats readily. As a rule if the stover is to be stacked in fair sized stacks it should remain in the shock at least two months, as it will heat if stacked before this time. If thrashed Kafir corn is to be kept in large quantities in tight bins through the spring and summer, great care must be exercised or it will heat and mold. This may happen to grain stored in the best of condition, particularly if the weather is a little damp, and the weevils get into it. Weevils are a great pest in this grain that is stored in bins during the summer, and do much damage. If the storing is for any length of time it is better accomplished while the grain is on the heads. The grain saved for planting should be kept on the heads or if thrashed, in open sacks in a dry place. No legal weight for a bushel of Kafir corn has been adopted in Oklahoma, but it should be 56 pounds, and this is the legal weight in Kansas. The question is often asked how many pounds of the grain in the head should be allowed for a bushel of grain. It requires from 75 to 80 pounds. If the heads are large and well filled and cut close to the butt and are dry, 75 pounds of the heads will thrash out 56 pounds of grain. If the stems on them are long and are mixed with more or less leaves and are damp, it will take 80 pounds to yield 56 pounds of grain. A determination of the average of seven loads of Kafir heads, well tramped in and hauled several miles, gave two inches in depth in a wagon box three by ten feet as equal to one bushel of Kafir corn.

Where the seed is planted as we have recommended, it will require six to ten pounds per acre.

The statement is quite commonly made that Kafir corn is hard on the soil. This is true only to the extent that it is a very heavy producer and draws on the soil to that extent for plant food and moisture. It generally leaves the ground well sapped of moisture and if sufficient rain does not fall to wet the soil thoroughly before the next crop is planted it is likely to do poorly on account of the lack of moisture. The crop does not remove any particular element from the soil that is felt by following crops other than is removed by most other crops. The very extensive and vigorous root system of the Kafir corn affords a larger feeding surface than that of most of the common crops.

## OATS.

The oats crop is not an extensive one on the station farm as a rule, but more or less of it is grown each season and usually the yields are good, many times they are excellent and seldom very poor. Few special experiments have been carried on with oats at this station, but it is included every year in several rotation experiments, and a few variety tests are under way.

### RESULTS IN 1900.

During the season of 1900 the work was limited to one plat. The soil, which is classified as clay loam, was plowed February 26th to a depth of seven inches. The plat was harrowed immediately after plowing and again prior to seeding. On March 2nd, the oats were put in with a grain drill at the rate of 3.2 bushels per acre. The soil was in good condition at time of seeding and the grain germinated promptly. The crop made a very fair growth during the season and was harvested June 16th. Texas Red variety was grown and it gave a yield of 72 bushels of grain per acre and 2.19 tons of straw.

### RESULTS IN 1901.

In 1901, four plats were seeded to Texas Red oats. These plats are used in continuous work and a three years' rotation is being followed on the series. The crops grown are: first year, corn; second year, oats; and third year, wheat and cowpeas. Two of the plats receive manure from time to time as the yield of various crops indicates the need for same. No manure was applied during the season of 1901. The two remaining plats received no manure, otherwise they received the same treatment as the manured plats. The soil on these plats, which is designated as a clay loam having a heavy impervious sub-soil, is quite uniform in character.

The ground was disked February 28th and plats were all seeded March 1st with grain drill at rate of 2.6 bushels per acre. The soil was in fair condition at time of seeding and the oats made a good growth up to the first of May when they were checked somewhat by dry weather. The oats on the manured plats made a better showing and matured earlier than those on the unmanured plats. On June 20th the oats were harvested. The manured plats gave an average yield of 54.5 bushels of grain per acre with 1.24 tons of straw, while in case of unmanured plats the average yield per acre was 28.6 bushels grain and .54 tons of straw. This gives a difference of 25.9 bushels of grain and .7 tons of straw in favor of manured plats.

### RESULTS IN 1902.

Four plats were seeded to oats in 1902. Three of these plats were one-eighteenth of an acre in extent and were used in making a comparison of three different varieties, namely, Lincoln, Culberson and Texas Red oats. The fourth plat contained one-half acre and was seeded to Texas Red oats. The soil, which was quite uniform in character, has been described under experiments for the years 1900 and 1901. In the case of the individual plat, the ground was plowed the 21st of January. The plat was seeded to oats with grain drill on March 4th at rate of 3.1 bushels per acre. The soil was disked and harrowed prior to seeding. The thrashing was done June 24th and the crop gave a return of 65.3 bushels per acre with 1.32 tons straw.

The treatment of soil in case of the varieties was somewhat different as compared with the individual plat. Cowpeas were grown on the field during the season of 1901 and the soil was kept clean and in good tilth by frequent cultivations. The cowpeas were harvested August 28th and the soil was given a thorough disking. Two plats, 39 and 40, were seeded to Culberson and Texas Red oats respectively. These made a fair showing in the fall but killed out during the winter. In the spring the portion of the field included in this experiment was disked and seeded at the rate of three bushels per acre from March 6th to 15th. The crop was harvested the 26th of June and the yields per acre were as follows:

| | Grain Bu. | Straw Tons. |
|---|---|---|
| Texas Red.......... ........ | 57.5 | 1.29 |
| Culberson.. .. .... .......... | 46.4 | 1.03 |
| Lincoln .... ................ .. | 45.3 | 1.13 |

In this test, the Texas Red oats gave a yield of 12.2 bushels more per acre than the Lincoln variety and 11.1 bushels more than the Culberson variety. These results are in accord with results which have been obtained at the station in previous years. The Texas Red variety has proved to be one of the most promising varieties in the list. In comparing the yields of oats from the smaller plats with the yield from the large plat there is still a greater difference in favor of the Texas Red variety.

## RESULTS IN 1903.

The work during the season of 1903 may be divided into two distinct experiments. First, oats grown in rotation of five years on manured and unmanured plats; second, time of seeding with different methods of cultivation in the preparation of the seed bed. In the first instance Texas Red oats were grown while in the latter case Texas Red oats were used with a mixed variety, sown in about equal parts.

### OATS IN ROTATION.

The plats in this experiment are located on Field D and a five year rotation is carried out as follows: Castor beans, Kafir, cotton, oats, wheat and soy beans. Two plats receive manure whenever crops appear to indicate a need for same. Manure was applied to these plats prior to plowing land for crop of cotton which was grown during season of 1902. The remaining plats have received no manure, otherwise the treatment of the series in regard to cultivation is the same. On March 31st the plats were plowed to a depth of six inches and the cotton stalks which had been previously cut with a stalk cutter were turned under thoroughly. The ground was then double harrowed and the grain was sown at the rate of 2.6 bushels per acre. The soil at the time of seeding was in an ideal condition hence perfect germination was obtained. A very heavy rain occurred on April 9th and the soil was washed to quite an extent. In many cases the young plants were completely submerged in the sediment which was deposited. If light showers had not followed, conditions would have been very unfavorable for growth in a few weeks because the soil was very compact and with no cultivation to check evaporation, the plants would have lacked for moisture. The season as a whole was moist and the oat crop made quite a rank growth. Conditions were exceedingly favorable for the development of rust and the crop, not only on the station farm, but also over a large portion of the territory, was seriously injured by it. Plats that under normal conditions would have given a yield of sixty or more bushels per acre gave a return of ten to fifteen bushels per acre. Loose smut was also quite prevalent on all plats this season. The crop on these plats was harvested on July 6th. This is much later than usual for harvesting owing to the fact that oats were not seeded until quite late. The oats on manured soil gave an average yield of 9.12 bushels per acre, with 1.66 tons of straw, and the unmanured plats gave an average yield of 10.6 bushels per acre with 1.42 tons of straw. In making a comparison of these results, we find that the manured plats produced the largest average yield of straw but the average yield of grain was lower by 1.48 bushels than the amount produced on the unmanured plats. This fact should be considered, however, that rust developed to a greater extent on the straw of oats grown on manured ground, hence the yield was diminished.

## TIME OF SEEDING.

Considerable rainfall occurred during the month of March, 1903, and as the soil was already well saturated with moisture which had fallen during the winter, it was impossible to prepare a seed bed for the oat crop at an early date. Under such circumstances the question always arises, "Will it pay to take time to plow land which has not already been plowed or shall surface cultivation be given and the crop seeded as soon as possible?" Again, would it be preferable to allow the soil to settle and thus cultivate at a time when a larger area could be covered per day at a much lower cost? With these questions in view an experiment was outlined and carried through in order to obtain if possible some information on the line indicated.

Eighteen plats were used in this work and they were divided into three series, each series being carried through in duplicate. First series: Plats 1 and 10 were plowed to a depth of five inches and seeded to oats with drill at rate of 3.0 bushels per acre on March 17th to 20th. The soil was harrowed after plowing. Plats 2 and 11 were double disked, harrowed and drilled at same rate per acre and on same date as above. On plats 3 and 12, the oats were sown broadcast and the ground was double disked and harrowed on same date, March 17th to 20th. The plats were seeded at the same rate per acre as plats 1 and 10. The soil at this time was very wet and it was almost impossible to work machinery. Six plats were used in this series.

Second series: Plats 4 and 13 were plowed to a depth of five inches, harrowed and seeded to oats with drill at rate of 3.0 bushels per acre on March 28th to 31st. Plats 5 and 14 were double disked, harrowed and seeded to oats with drill using same amount of grain per acre, and on same date as plowed plats, March 28th to 31st. Plats 6 and 15 were a repetition of work as followed on plats 5 and 14. The soil was in a much better condition at this time for working as compared with the earlier seeding, but it was still quite moist in places.

Third series: Plats 7 and 16 were plowed to a depth of five inches, harrowed and seeded with drill at rate of 3.0 bushels per acre on April 7 to 9. Plats 8 and 17 were double disked, harrowed, and seeded with drill at same rate per acre and on same date as plowed plats. Plats 9 and 18 were given the same treatment as plats 8 and 17, and were seeded at same time. The soil was in much better condition for seeding at this date than at either of the earlier seedings. Very heavy rains occurred after the first series had been seeded and again on April 9th after all plats had been sown. The soil was not only washed to a considerable extent but it was also packed quite firmly and the young plants were forced to grow under somewhat adverse conditions.

As noted in the former experiment of this year the weather during the growing season was rather moist, but oats on this field did not make as rank a growth as on other fields. The soil would be classed as upland and as no manure has been applied to the field for some time, the soil is rather deficient in humus. In the second place, rust developed to quite an extent on all plats, and more especially on plats that were put in late than on the early seeding plats, and this had a tendency to reduce the yields very materially. This was quite apparent in connection with returns from the late seeding plats. The oats on these plats made a ranker growth than those on early and medium seeding plats. The soil on the early and medium seeding plats was packed quite firmly by the heavy rains which followed seeding, thus placing the oats under somewhat more unfavorable circumstances for growth in regard to the physical condition of the soil than the crop which was seeded at a later date.

AVERAGE YIELD OF OATS FROM PLATS RECEIVING SAME TREATMENT.

| Plat No. | Yield Straw | Yield Grain | Tests | Date of Plowing & Seeding | Treatment which plats received. |
|---|---|---|---|---|---|
| 1 & 10 | .51 | 15.7 | 26.5 | March 17-20 | Powed, harrowed, drilled |
| 2 & 11 | .46 | 12.6 | 25.0 | March 17-20 | Double disked, har., dr'ld |
| 3 & 12 | .55 | 12.8 | 25.0 | March 17-20 | B'dc'st, d'ble d'sk'd, har. |
| 4 & 13 | .73 | 6.0 | 17.0 | March 28-31 | Plowed, harrowed, drilled |
| 5 & 14 | .67 | 8.2 | 20.0 | March 28-31 | Double disked, har., dr'ld |
| 6 & 15 | .62 | 9.0 | 18.2 | March 28-31 | Double disked, har., dr'ld |
| 7 & 16 | .65 | 3.2 | 16.2 | April 7-9 | Plowed, harrowed, drilled |
| 8 & 17 | .60 | 4.5 | 16.5 | April 7-9 | Double disked, har., dr'ld |
| 9 & 18 | .69 | 2.7 | 16.0 | April 7-9 | Double disked, har., dr'ld |

In summing up these results we find that the early seeding plats gave the lowest yield of straw per acre, and highest yield of grain. The grain in this case also gave a better test per measured bushel than the medium or late seedings. In the early seeding, the plowed plats gave the largest returns in yield of grain as compared with plats which were worked up with a disk. With the later seedings the reverse is the case and we find that the disked plats give the largest yield of grain but do not give as large a yield of straw as plowed plats. The yield of grain on the plowed plats of the medium and late seedings may have been influenced by the extra amount of rust which developed on these oats. The crop was more luxuriant on plowed plats than on land which received surface cultivation only, hence rust had a better chance to grow and spread on these plants.

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# DISINFECTING POWER OF COAL-TAR DIPS.

## INTRODUCTION.

The experiments reported in this bulletin were undertaken to determine the value as disinfectants of various preparations commonly known as coal-tar dips. The object was not primarily to find their value as disinfectants as compared with one another, but to see if any or all of them were reliable disinfectants when used in very dilute solutions. The dips tested that properly come under the head of coal-tar preparations are Zenoleum, Cremoline, Lincoln Dip, Car-Sul, Moore's Hog Remedy and Chloro-Naptholeum. The other preparations tested were carbolic acid, kerosene emulsion and Mortipest Sheep Dip. Samples of these dips were obtained on the market with the exception of Cremoline and Mortipest, these being sent to the experiment station from the manufacturers. Cremoline had been in the laboratory about six months before it was tested while Mortipest was received after the work was started; samples of the other dips had been in the laboratory for about two years.

No chemical analysis was made of any of the dips to determine the per cent of phenols or other substances and the advertising matter from the various companies gives no idea of their composition except in the case of the Lincoln Dip where such preparations as oils, sulphur and nicotine are mentioned. It is not likely that dips of this character are always uniform in their composition and for this reason samples obtained from different sources might give results materially different from those obtained in this series of experiments. However, considering the general way in which these dips are prepared, it is possible to obtain a nearly uniform product when such is desired. The basis from which the coal-tar dips are made is the heavy oils of tar which may be collected in the distillation of coal and the manufacture of coke or illuminating gas. These oils are saponified more or less completely in order to cause them to mix readily with water and form an emulsion when they are diluted for use. All of the coal-tar dips are heavy black liquids varying in specific gravity from 1.037 to 1.060. They are readily miscible with water giving a milky color to the mixture. In many cases the mixtures made in the laboratory were allowed to stand for several days without any noticeable separation of the dip and water. In most of them a small amount of oil will collect in drops or globules on the surface and some black sediment will usually collect on the bottom of the flask after the solution stands for a few hours but these do not interfere at all with the use of the preparation. The mixture of these dips with water is commonly referred to as a solution but they are emulsions formed with saponified oils of tar. However, the term solution is commonly used in referring to such preparations of dips and it will be used in this connection in the following pages.

There is no way to estimate the general value of disinfectants when properly prepared and used. They not only kill the germs of disease that may be present but by using them such germs are not able to begin their growth. Practically all communicable diseases that are caused by bacteria can be limited to some degree by using a good disinfectant and many of them are of such a nature as to be easily controlled when disinfectants are used. If germs of the various diseases can be killed in the laboratory experiments they can be killed in practical sanitary work if the disinfectant is brought into contact with the germ. The efficiency of work with disinfectants depends on the thoroughness with which it is done as there can be no half-way disinfection. The method employed in laboratory experiments is such as to bring the disinfectant into contact with every germ, hence the uniform results when the solution is of sufficient strength to kill the germs. Such results are possible in actual practice if the solution is used in sufficient quantity and strength.

## METHOD OF TESTING THE DIPS.

The method first used in testing the efficiency of the dips consisted in adding one cc. of a 24 hour bouillon culture of the organism to 98 cc. of sterile water plus one cc. of the dip to be tested. The water and dip were thoroughly mixed before the culture of the germ was added. After the culture was placed in the solution of dip it was thoroughly shaken and a drop taken out at the stipulated time and placed in 5 cc. of water for the purpose of washing the disinfectant from the germ. Agar plates were made from the tubes containing the washed germs using three and five loops respectively in the two plates (a loop is about 1-10 of a drop). The colonies in all plates were counted at the end of 96 hours incubation at 37 degrees C. The question arose in this method as to the effect of the dip solution carried over into the blank on the bacteria therein, and whether it would have any effect on their growth in the plates. To answer this checks were made by placing one cc. of the same culture in 99 cc. of water and carrying a drop over into a 5 cc. water blank and plating as above, then adding to this charged blank one drop of a sterile one per cent solution of the same dip used and plating again in the same manner. The checks made by both methods showed no variation so it was concluded that the small amount of disinfectant carried over had no ill effect. The disinfectant carried from the one per cent solution to the 5 cc. water blank made a solution of the disinfectant in the water blank of one to fifteen thousand.

The following table gives the results obtained from the above method.

Table No. 1.

Effect of a one per cent solution of Lincoln Dip on a 24 hour bouillon culture of the following organisms.

| NAME OF GERM | Average Number of Bacteria Per Loop and Number of Minutes Germs Were Exposed to Disinfectant. | | | | | | |
|---|---|---|---|---|---|---|---|
| | Check | 0 | 1 | 3 | 5 | 8 | 10 |
| B. hog cholera | 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| B. swine plague | 6 | 0 | 0 | 0 | 0 | 0 | 0 |
| M. aureus | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| B. coli | 4 | 0 | 0 | 0 | 0 | 0 | 0 |
| B. subtilis | 2 | 0 | 0 | 0 | 0 | 0 | 0 |

It will be seen from this table that this method gives too few organisms in the check plates which makes the results unsatisfactory. To overcome this it was suggested that either an older bouillon culture be used, one in which the number of bacteria had materially increased over that in a 24 hour culture, or that more of the 24 hour culture be used, or that the germ be grown on agar slopes and the growth removed to a sterile water blank, thoroughly agitated and filtered to remove the clumps. These three methods were therefore tried using the same procedure in every other respect as in the preceding experiment. In order to use more of the bouillon culture, as outlined in the second suggestion, 94 cc. of water was mixed with 5 cc. of a 48 hour bouillon culture of the germ to be tested and one cc. of the dip added to this, making a one per cent solution.

The following table gives the results obtained by trying each of the three methods using Lincoln Dip in a one per cent solution.

Table No. 2.

| CULTURE OF B. COLI USED | Average Number of Bacteria Per Loop and Number of Minutes Germs were Exposed to Action of Disinfectant. | | | | | |
|---|---|---|---|---|---|---|
| | Check | 1 | 5 | 5 | 8 | 10 |
| Seven day bouillon culture | 18 | ‡ | 0 | 0 | 0 | 0 |
| Filtered culture from agar | 18 | 0 | 0 | 0 | 0 | 0 |
| Five cc. bouillon culture, water, 94 cc.; dip 1 cc. | 147 | 5 | 0 | 0 | 0 | 0 |

‡Average less than one per loop.

It is apparent from the above results that the number of germs in the check plates is too small in all except the last, where five cc. of the bouillon culture was added to 94 cc. of water. The other methods were discarded and the latter used for the remainder of the work. Instead, however, of using the 24 hour culture, 48 hour cultures were used as this gave a greater number of colonies in the check plates which was very desirable.

The following is a complete description of the method as followed in the remainder of the work. Five cc. of a 48 hour bouillon culture of the germ to be used were added to 94 cc. of sterile water and thoroughly mixed by shaking. One drop of this mixture was added to 5 cc. of sterile water and three and five loops respectively were added to two agar tubes and plates poured. These were the check plates. After the check plates were poured one cc. of the disinfectant to be tested was added to the mixture of germs and water, making 100 cc. in the flask, less what was used in making the check plates, or a one per cent solution of the disinfectant. At the end of the time indicated in the various tables one drop of the solution was placed in 5 cc. of sterile water and from this plates were poured, using three loops for one and five for the other as was done in making the check plates. The columns indicating the 0 time mean that the drop was removed from the flask as quickly as possible after the disinfectant was added, which would be in from ten to twenty seconds. This method gives as perfect distribution and exposure of the germs to the disinfectant as can be obtained by any method and the washing of the germs in the sterilized water prevented the carrying of any quantity of the disinfectant over into the agar plates. It will also be noticed that the plates containing the germs acted upon by the disinfectant were prepared as were the check plates, so that the difference noticed in the number of germs in the check plates and in the 0 column is due to the action of the disinfectant for the short length of time necessary to mix the disinfectant and the water containing the germs and to remove a drop, which as before stated, was usually from ten to twenty seconds.

The tables given are made up from laboratory notes of the experiment. The following table is from the laboratory notes and the last line or average is found in table No. 5.

Duplicate test of 1 per cent solution of Zenoleum on B. anthracis.

| Time germ was exposed to solution | Check | 0 | ½ | 1 | 2 |
|---|---|---|---|---|---|
| Number of germs in three loops | 20 | 8 | 4 | 4 | 5 |
| Number of germs in five loops | 62 | 7 | 7 | 8 | 9 |
| Average number of germs per loop | 10 | 2 | 1 | 1 | 2 |

Duplicate tests were always made but were never made on the same day or from the same cultures but were always made from cultures and solutions prepared in every way as for the original test.

It will be noticed in connection with table No. 3 that the result of the test indicates the complete disinfection of the preparation containing the B. subtilis and this is also seen in table No. 5 in the original test on B. anthracis. As is well known both organisms are spore producing and are difficult to destroy by the use of disinfectants. These results mean that in those particular cultures the germs had not formed spores as tests were made in a number of the experiments to determine spore formation. These tests were made by heating the tubes from which the check plates were made to 80 degrees C. for ten minutes, after which plates were poured as in making the checks. The results showed that when spores were present the colonies in the plates made from the tubes after heating were about as numerous as were the colonies in the plates that had been acted on by the disinfectant. This indicates that the disinfectants as used had no effect on the spores.

## EXPLANATION OF TABLES.

The figures given in the tables (fractions omitted) are the averages obtained in the experiment by using a one per cent solution of the various dips. The spaces containing zeroes indicate that all of the germs were killed and spaces containing the dash indicate that no test was made for that time. The figures at the head of the columns indicate the number of minutes the germ was exposed to the disinfectant. As a rule such germs as hog cholera, swine plague etc., were exposed for a shorter length of time than was given to the anthrax or subtilis. After the first tests showed that the solution was effective for certain germs the time was cut down to two minutes for all except the anthrax and subtilis germs, and these were generally exposed for the full time of 30 minutes. In all cases. unless a statement to the contrary is made, the tests were made on a 48 hour bouillon culture grown at 30 to 35 degrees Centigrade and the colonies were counted after the plates had been incubated for 72 hours at the same temperature.

## BACTERIA USED IN THE EXPERIMENT.

The bacteria used in the experiment are such as would give a fair test of the disinfecting qualities of any drug, the germs causing hog cholera and swine plague being comparatively easy to kill while the aureus is a very resistant germ and its common use in experimental work makes it a desirable germ to use. The Bacillus of anthrax and B. subtilis were used as types of the spore producing bacteria. The Bacillus of typhoid fever which was used in table No. 13 is another germ that is very commonly used in testing disinfectants. Its relation to typhoid fever and its presence in the stools from typhoid patients makes it very necessary to use some disinfectant in order to make such infected material harmless.

### AGE OF CULTURES.

The age of cultures, even in the non-spore producing forms, has considerable to do with the disinfecting power of any substance. In table No. 12 the test was made with a one per cent solution of Lincoln Dip on all of the germs used in the experiment when cultivated forty-eight hours, eight, and seventeen days. In old cultures the non-spore producing forms become very resistant and under such conditions are more difficult to kill with a disinfectant than when they are in young cultures. This may account in many cases for the failure of certain substances to act as a disinfectant in wounds or abscesses where the same strength of solution was found to be effective in laboratory work. In such cultures as hog cholera and swine plague the difference in the resisting power of the forty-eight hour culture and the eight day culture is very marked but this difference does not increase in proportion in the seventeen day culture.

Table No. 3.

Disinfecting power of one-half per cent solution of Lincoln Dip.

| NAME OF GERM | Average Number of Bacteria Per Loop and Number of Minutes Germs were Exposed to Disinfectant. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Check | 0 | 1 | 3 | 5 | 8 | 10 | 15 |
| B. hog cholera | 151 | 61 | 60 | 51 | 20 | 24 | 11 | ... |
| Duplicate | 147 | 63 | 59 | 33 | 32 | 36 | 21 | 14 |
| B. swine plague | 121 | 28 | 18 | 12 | 10 | 7 | 8 | ... |
| Duplicate | 107 | 31 | 9 | 4 | 3 | 1 | 2 | 1 |
| M. aureus | 21 | 7 | 6 | 6 | 7 | 5 | 11 | ... |
| Duplicate | 12 | 5 | 4 | 6 | 2 | ‡ | ‡ | ... |
| B. coli | 143 | 114 | 81 | 38 | 36 | 4 | 1 | ... |
| Duplicate | 27 | 9 | 9 | 3 | 2 | 1 | 1 | ... |
| B. subtilis | 8 | 0 | 0 | 0 | 0 | 0 | 0 | ... |
| Duplicate | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

‡ Average less than one per loop.

## Table No. 4.

Disinfecting power of one per cent solution of Lincoln Dip.

| NAME OF GERM | Average Number of Bacteria Per Loop and Number of Minutes Germs were Exposed to Disinfectant. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Check | 0 | ½ | 1 | 2 | 3 | 5 | 8 | 10 | 12 | 15 | 30 |
| B. hog cholera | 205 | 8 | ..... | 0 | ... | 0 | 0 | 0 | 0 | ... | ... | ... |
| Duplicate | 388 | 180 | 193 | 95 | 55 | ... | ... | ... | ... | ... | ... | ... |
| B. swine plague | 70 | 0 | ..... | 0 | ... | 0 | 0 | 0 | 0 | ... | ... | ... |
| Duplicate | 407 | 187 | 217 | 70 | 8 | ... | ... | ... | ... | ... | ... | ... |
| M. aureus | 44 | 14 | ..... | 0 | ... | 0 | 0 | 0 | 0 | ... | ... | ... |
| Duplicate | 54 | 28 | 16 | 18 | 9 | ... | ... | ... | ... | ... | ... | ... |
| B. coli | 39 | 0 | ..... | 0 | ... | 0 | 0 | 0 | 0 | ... | ... | ... |
| Duplicate | 422 | 99 | 106 | 67 | 51 | ... | ... | ... | ... | ... | ... | ... |
| B. subtilis | 73 | 20 | 24 | 25 | ... | 24 | 17 | 24 | ... | 21 | 21 | 19 |
| Duplicate | 28 | 7 | 4 | 9 | 7 | ... | 11 | 9 | 8 | ... | 11 | 10 |
| B. anthracis | 25 | 2 | 2 | 2 | ... | 2 | 2 | 1 | ... | 3 | 2 | 3 |
| Duplicate | 31 | 6 | 6 | 6 | 7 | ... | 8 | 6 | 11 | ... | 5 | 7 |

The original tests in the above table were made August 24, 1903 and the duplicate tests were made February 8, 1904. By comparing the results it will be seen that the dip was effective in the first tests and that it had practically lost its disinfecting properties by the time the second tests were made.

## Table No. 5.

Disinfecting power of one per cent solution of Zenoleum.

| NAME OF GERM | Average Number of Bacteria Per Loop and Number of Minutes Germs were Exposed to Disinfectant. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Check | 0 | ½ | 1 | 2 | 3 | 5 | 8 | 10 | 12 |
| B. hog cholera | 126 | 0 | ... | 0 | ... | 0 | 0 | 0 | 0 | ... |
| Duplicate | 123 | 0 | 0 | 0 | 0 | ... | ... | ... | ... | ... |
| B. swine plague | 113 | 0 | ... | 0 | ... | 0 | 0 | 0 | 0 | .. |
| Duplicate | 181 | 0 | 0 | 0 | 0 | ... | ... | ... | ... | ... |
| M. aureus | 57 | 3 | ... | 0 | .. | 0 | 0 | 0 | 0 | ... |
| Duplicate | 16 | 4 | 0 | 0 | 0 | ... | ... | ... | ... | ... |
| B. coli | 485 | 0 | ... | 0 | ... | 0 | 0 | 0 | 0 | ... |
| Duplicate | 93 | 0 | 0 | 0 | 0 | ... | ... | ... | ... | ... |
| B. subtilis | 20 | 0 | ... | 0 | ... | 0 | 0 | 0 | 0 | ... |
| Duplicate | 14 | 1 | ‡ | ‡ | 1 | ... | ... | ... | ... | ... |
| B. anthracis | 7 | 0 | ... | 0 | ... | 0 | 0 | 0 | 0 | ... |
| Duplicate | 10 | 2 | 1 | 1 | 2 | ... | ... | ... | ... | ... |

‡ Average less than one per loop.

## Table No. 6.

### Disinfecting power of one per cent solution of Car-Sul.

| NAME OF GERM | Average Number of Bacteria Per Loop and Number of Minutes Germs were Exposed to Disinfectant. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Check | 0 | ½ | 1 | 2 | 3 | 5 | 8 | 10 | 12 | 15 | 30 |
| B. hog cholera | 187 | 0 | 0 | 0 | 0 | ... | ... | ... | ... | ... | ... | ... |
| Duplicate | 169 | ‡ | 0 | ‡ | 0 | ... | ... | ... | ... | ... | ... | ... |
| B. swine plague | 211 | 0 | 0 | 0 | 0 | ... | ... | ... | ... | ... | ... | ... |
| Duplicate | 368 | 0 | 0 | 0 | 0 | ... | ... | ... | ... | ... | ... | ... |
| M. aureus | 8 | 1 | 1 | 0 | 0 | ... | ... | ... | ... | ... | ... | ... |
| Duplicate | 26 | 4 | 1 | ‡ | 0 | ... | ... | ... | ... | ... | ... | ... |
| B. coli | 280 | 0 | 0 | 0 | 0 | ... | ... | ... | ... | ... | ... | ... |
| Duplicate | 439 | ‡ | 0 | 0 | 0 | ... | ... | ... | ... | ... | ... | ... |
| B. subtilis | 115 | 13 | 17 | 23 | 15 | ... | ... | ... | ... | ... | ... | ... |
| Duplicate | 30 | 12 | 5 | 8 | 10 | ... | 9 | 8 | 10 | ... | 12 | 11 |
| B. anthracis | 15 | 2 | 2 | 2 | 2 | ... | 3 | 2 | 3 | ... | 3 | 3 |
| Duplicate | 20 | ‡ | 0 | ‡ | 0 | ... | ‡ | 0 | 0 | ... | 0 | 0 |

‡ Average less than one per loop.

## Table No. 7.

### Disinfecting power of one per cent solution of Cremoline.

| NAME OF GERM | Average Number of Bacteria Per Loop and Number of Minutes Germs were Exposed to Disinfectant. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Check | 0 | ½ | 1 | 2 | 3 | 5 | 8 | 10 | 12 | 15 | 30 |
| B. hog cholera | 440 | 0 | 0 | 0 | 0 | ... | ... | ... | ... | ... | ... | ... |
| Duplicate | 212 | 0 | 0 | 0 | 0 | ... | ... | ... | ... | ... | ... | ... |
| B. swine plague | 166 | 0 | 0 | 0 | 0 | ... | ... | ... | ... | ... | ... | ... |
| Duplicate | 438 | 0 | 0 | 0 | 0 | ... | ... | ... | ... | ... | ... | ... |
| M. aureus | 10 | 3 | 0 | 0 | 0 | ... | ... | ... | ... | ... | ... | ... |
| Duplicate | 73 | ‡ | ‡ | 0 | 0 | ... | ... | ... | ... | ... | ... | ... |
| B. coli | 217 | 0 | 0 | 0 | 0 | ... | ... | ... | ... | ... | ... | ... |
| Duplicate | 622 | 0 | 0 | 0 | 0 | ... | ... | ... | ... | ... | ... | ... |
| B. subtilis | 8 | ‡ | 0 | 1 | 1 | ... | ... | ... | ... | ... | ... | ... |
| Duplicate | 17 | 5 | 9 | 8 | 4 | ... | 5 | 4 | 7 | ... | 9 | 6 |
| B. anthracis | 1 | ‡ | 0 | 0 | 0 | ... | ... | 0 | ... | ... | 0 | ‡ |
| Duplicate | 17 | ‡ | ‡ | ‡ | 1 | ... | ‡ | 0 | 1 | 1 | ‡ | ‡ |

‡ Average less than one per loop.

## Table No. 8.

Disinfecting power of one per cent solution of Moore's Hog Remedy.

| NAME OF GERM | Average Number of Bacteria Per Loop and Number of Minutes Germs were Exposed to Disinfectant. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Check | 0 | ½ | 1 | 2 | 3 | 5 | 8 | 10 | 12 | 15 | 30 |
| B. hog cholera | 80 | 0 | 0 | 0 | 0 | ... | ... | ... | ... | ... | ... | ... |
| Duplicate | 172 | 0 | 0 | 0 | 0 | ... | ... | ... | ... | ... | ... | ... |
| B. swine plague | 42 | 0 | 0 | 0 | 0 | ... | ... | ... | ... | ... | ... | ... |
| Duplicate | 166 | 0 | 0 | 0 | 0 | ... | ... | ... | ... | ... | ... | ... |
| M. aureus | 23 | 2 | 0 | 0 | 0 | ... | ... | ... | ... | ... | ... | ... |
| Duplicate | 11 | 0 | 0 | 0 | 0 | ... | ... | ... | ... | ... | ... | ... |
| B. coli | 27 | 0 | 0 | 0 | 0 | ... | ... | ... | ... | ... | ... | ... |
| Duplicate | 244 | ‡ | 0 | 0 | 0 | ... | ... | ... | ... | ... | ... | ... |
| B. subtilis | 16 | 2 | 6 | 3 | 1 | ... | ... | ... | ... | ... | ... | ... |
| Duplicate | 30 | 1 | 0 | ‡ | ‡ | ... | ‡ | ... | ... | ... | ... | ... |
| B. anthracis | 22 | 5 | 1 | 2 | 3 | ... | 2 | 1 | 2 | ... | 2 | 2 |
| Duplicate | 9 | ‡ | ‡ | ‡ | ‡ | ... | ‡ | ‡ | ‡ | ... | 0 | ‡ |

‡Average less than one per loop.

## Table No. 9.

Disinfecting power of one per cent solution of Chloro-Naptholeum.

| NAME OF GERM | Average Number of Bacteria Per Loop and Number of Minutes Germs Were Exposed to Disinfectant. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Check | 0 | ½ | 1 | 2 | 3 | 5 | 8 | 10 | 12 | 15 | 30 |
| B. hog cholera | 112 | 0 | 0 | 0 | 0 | ... | ... | ... | ... | ... | ... | ... |
| Duplicate | 674 | 0 | 0 | 0 | 0 | ... | ... | ... | ... | ... | ... | ... |
| B. swine plague | 124 | 0 | 0 | 0 | 0 | ... | ... | ... | ... | ... | ... | ... |
| Duplicate | 511 | 0 | 0 | 0 | 0 | ... | ... | ... | ... | ... | ... | ... |
| M. aureus | 51 | 0 | 0 | 0 | 0 | ... | ... | ... | ... | ... | ... | ... |
| Duplicate | 27 | 1 | 0 | 0 | 0 | ... | ... | ... | ... | ... | ... | ... |
| B. coli | 53 | ‡ | 0 | 0 | 0 | ... | ... | ... | ... | ... | ... | ... |
| Duplicate | 450 | 0 | 0 | 0 | 0 | ... | ... | ... | ... | ... | ... | ... |
| B. subtilis | 37 | ‡ | ‡ | 2 | 0 | ... | ... | ... | ... | ... | ... | ... |
| Duplicate | 74 | 20 | 17 | 17 | 15 | ... | ... | ... | ... | ... | ... | ... |
| B. anthracis | 17 | ‡ | ‡ | ‡ | ‡ | ... | ‡ | ‡ | ‡ | ... | ‡ | ‡ |
| Duplicate | 52 | 7 | ... | 6 | 6 | ... | 5 | 16 | 9 | ... | 8 | 8 |

‡Average less than one per loop.

## Table No. 10.

Disinfecting power of one per cent solution of Mortipest Sheep Dip and of kerosene emulsion.

| NAME OF GERM | Average Number of Bacteria Per Loop and Number of Minutes Germs Were Exposed to Disinfectant. | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mortipest | | | | | Kerosene Emulsion | | | | | |
| | Check | 0 | ½ | 1 | 2 | Check | 0 | 1 | 2 | 5 | 8 |
| B. hog cholera | 118 | 182 | 67 | 84 | 76 | 163 | 41 | 12 | 11 | 2 | 1 |
| B. swine plague | 525 | 220 | 295 | 337 | 282 | 428 | 23 | 7 | 4 | 2 | 4 |
| M. aureus | 5 | 5 | 4 | 3 | 3 | 14 | 3 | 3 | 2 | 1 | ‡ |
| B. coli | 875 | 852 | 675 | 408 | 732 | 244 | 40 | 139 | 37 | 18 | 8 |
| B. subtilis | 243 | 142 | 27 | 146 | 40 | 30 | 3 | 3 | 3 | 2 | 2 |
| B. anthracis | 112 | 101 | 109 | 98 | 57 | 7 | ‡ | ‡ | 1 | ‡ | ‡ |

‡Average less than one per loop.

Mortipest has the appearance and odor of a nicotine dip. It mixes readily with water giving a dark straw color.

The kerosene emulsion was made according to the following formula:

Hard soap, one-half pound, kerosene, two gallons, water, one gallon.

Dissolve the soap in the water by boiling, remove from the fire and add the kerosene and spray back until thoroughly emulsified. To this add seven gallons of water when ready to use.

This test was not run in duplicate as neither preparation possessed any marked disinfecting power.

## Table No. 11.

Disinfecting power of one per cent solution of carbolic acid.

| NAME OF GERM | Average Number of Bacteria Per Loop and Number of Minutes Germs Were Exposed to Disinfectant. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Check | 0 | ½ | 1 | 2 | 3 | 5 | 8 | 10 |
| B. hog cholera | 573 | 1 | 0 | 0 | 0 | ... | ... | ... | ... |
| B. swine plague | 315 | 3 | 0 | 0 | 0 | ... | ... | ... | ... |
| M. aureus | 62 | 3 | 0 | 0 | 0 | ... | ... | ... | ... |
| B. coli | 315 | 34 | ‡ | 0 | 0 | ... | ... | ... | ... |
| B. subtilis | 82 | 17 | 20 | 6 | 9 | ... | ... | ... | ... |
| B. anthracis | 32 | 4 | ... | 5 | 4 | ... | 4 | ... | 6 |

‡Average less than one per loop.

Carbolic acid was used in the same strength solution as the coal-tar preparations because it is the disinfectant in most common use. By comparing the results obtained with the carbolic acid and the other preparations tested it will be seen that it is a no better disinfectant than Zenoleum, Chloro-Naptholeum, Car-Sul, etc.

### Table No. 12.

Disinfecting power of one per cent solution of Lincoln Dip when used on cultures 48 hours old, eight and seventeen days old.

| NAME OF GERM | Age of Culture | Average Number of Bacteria Per Loop and Number of Minutes Germs Were Exposed to Disinfectant | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Check | 0 | ½ | 1 | 2 | 3 | 5 | 8 | 10 | 12 |
| B. hog cholera | 48 hrs | 205 | 8 | ... | 0 | ... | 0 | 0 | 0 | 0 | ... |
| " " | 8 days | 479 | 92 | 67 | 23 | 4 | ... | ... | ... | ... | ... |
| " " | 17 " | 124 | 53 | ... | 17 | 8 | ... | ‡ | ... | ... | ... |
| B. swine plague | 48 hrs | 70 | 0 | ... | 0 | 0 | 0 | 0 | 0 | ... | ... |
| " " | 8 days | 393 | 8 | 2 | 0 | 0 | ... | ... | ... | ... | ... |
| " " | 17 " | 1217 | 546 | ... | 214 | 173 | ... | 23 | ... | ... | ... |
| M. aureus | 48 hrs | 44 | 14 | ... | 0 | ... | 0 | 0 | 0 | 0 | ... |
| " | 8 days | 82 | 19 | 21 | 9 | 1 | ... | ... | ... | ... | ... |
| " | 17 " | 69 | 18 | ... | 16 | 12 | ... | 11 | ... | ... | ... |
| B. coli | 48 hrs | 39 | 0 | ... | 0 | ... | 0 | 0 | 0 | 0 | ... |
| " | 8 days | 212 | 37 | 11 | 1 | 1 | ... | ... | ... | ... | ... |
| " | 17 " | 92 | 30 | ... | 11 | 3 | ... | 3 | ... | ... | ... |
| B. subtilis | 48 hrs | 73 | 20 | 24 | 24 | 25 | ... | 24 | 17 | 24 | ... |
| " | 8 days | 53 | 19 | 18 | 8 | 15 | .. | ... | ... | ... | ... |
| " | 17 " | 185 | 19 | ... | 16 | 12 | ... | 19 | ... | ... | 15 |
| B. anthracis | 48 hrs | 25 | 2 | 2 | 2 | 2 | ... | 2 | 2 | 1 | 0 |
| " | 8 days | 39 | 9 | 11 | 7 | 10 | ... | 8 | 5 | 11 | 11 |
| " | 17 " | 82 | 37 | ... | 35 | 23 | ... | 28 | ... | 55 | 31 |

‡Average less than one per loop.

This table was completed on September 22, 1903, while the Lincoln Dip was as effective as any of the preparations that were tested.

### Table No. 13.

Table showing the effect of the various preparations tested when used on the Bacillus typhosus.

| NAME OF DIP | Average Number of Bacteria per Loop and Number of Minutes Germs Were Exposed to Disinfectant. | | | | |
|---|---|---|---|---|---|
| | Check | 0 | ½ | 1 | 2 |
| Mortipest | 139 | 122 | 68 | 77 | 118 |
| Duplicate | 204 | 164 | 143 | 126 | 161 |
| Carbolic acid | 133 | 0 | 0 | 0 | 0 |
| Duplicate | 46 | 12 | ‡ | 0 | 0 |
| Moore's Hog Remedy | 42 | 0 | 0 | 0 | 0 |
| Duplicate | 192 | 0 | 0 | 0 | 0 |
| Lincoln Dip | 154 | 51 | 48 | 40 | 12 |
| Duplicate | 100 | 36 | 29 | 17 | 5 |
| Chloro-Naptholeum | 85 | 0 | 0 | 0 | 0 |
| Duplicate | 55 | 0 | 0 | 0 | 0 |
| Car-Sul | 114 | 0 | 0 | 0 | 0 |
| Duplicate | 207 | 0 | 0 | 0 | 0 |
| Cremoline | 77 | 0 | 0 | 0 | 0 |
| Duplicate | 41 | 0 | 0 | 0 | 0 |
| Zenoleum | 101 | 0 | 0 | 0 | 0 |
| Duplicate | 138 | 0 | 0 | 0 | 0 |

‡Average less than one per loop.

The original test in the above table was made on Feb. 17, 1904 and the duplicate test was made on Feb. 20, 1904.

### Table No. 14.

Disinfecting power of a one per cent solution of Creolin-Pearson.

| NAME OF GERM | Average Number of Bacteria Per Loop and Number of Minutes Germs Were Exposed to Disinfectant. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Check | 0 | ½ | 1 | 2 | 5 | 8 | 10 | 15 |
| B. hog cholera | 501 | 0 | 0 | 0 | 0 | ... | ... | ... | ... |
| " " 7 day cultivation | 466 | 0 | 0 | 0 | 0 | ... | ... | ... | ... |
| B. swine plague | 588 | 0 | 0 | 0 | 0 | ... | ... | ... | ... |
| M. aureus | 102 | 3 | 0 | 0 | 0 | ... | ... | ... | ... |
| B. typhi | 189 | 0 | 0 | 0 | 0 | ... | ... | ... | ... |
| B. Coli | 239 | 0 | 0 | 0 | 0 | ... | ... | ... | ... |
| B. subtilis | 10 | 4 | 4 | 6 | 5 | 2 | 4 | 4 | 3 |
| B. anthracis | 174 | 91 | 82 | 74 | 68 | 64 | 78 | 68 | 94 |

By comparing the above table with other tables where one per cent solutions were used, it will be seen that the disinfecting power of the commercial dips compares very favorably with that of creolin. Creolin is a preparation of cresols and other hydrocarbons of coal tar held in emulsion by a resin soap. It has a very extensive use in both human and veterinary surgery as a disinfectant, and is also used quite extensively as a deodorizer. In appearance creolin is very much like the commercial dips, being a heavy black liquid, easily miscible with water and with a specific gravity of 1.045.

## GENERAL CONSIDERATIONS.

In any community where stock raising is the principal industry there is prevalent at all times some of the various diseases, caused by parasites or bacteria, that require some form of treatment in order to cure the disease or to limit its spread. In many of the skin diseases, the use of some effective remedy will act both as a cure and as a means of prevention. Remedies used in connection with infectious diseases should not be used merely as a cure but they are used much more effectively in many cases as a means of preventing the spread of the disease. The use of such preparations as will free the skin of parasites, such as lice, mange, mites, etc., or that will destroy the germs of such diseases as are common among farm animals, is coming to be very extensive since it is generally understood that such skin diseases can be cured or infectious diseases prevented from spreading by the use of some effective disinfectant.

The coal-tar preparations that were tested in this experiment are widely advertised as dips for all forms of external parasites, especially for sheep scab, mange in cattle and for hog lice. In another report it is expected to show the value of such preparations on skin parasites and on some of the skin diseases. Mortipest, one of the preparations used in these experiments is not sold as a disinfectant but as a sheep dip, and kerosene emulsion, although commonly used as a dip or wash to kill lice, was tested to determine its disinfecting properties. As the results show in table No. 10, neither preparation has any qualities as a disinfectant sufficient to warrant its use. All of the disinfectants tested, that properly come under the head of coal-tar preparations, are good disinfectants, they are cheap and non poisonous and should be extensively used where disinfectants are necessary.

The practical application of disinfectants is of importance to any one handling stock. Even when there is no contagious or infectious disease that would require the use of such remedies there is hardly a time on a stock farm when there is not occasion to use such remedies in dressing sores, wire cuts, etc. The coal-tar preparations are not irritating and may be used in wounds or sores without injury to the tissue. Such diseases as hog cholera, swine plague, glanders, etc., are infectious and animals may easily contract them by being placed in stalls or pens where diseased animals have been. In order to lessen the danger from such infection it is necessary to use disinfectants of some kind or allow the stables or pens to go unused for sufficient length of time for them to become disinfected by drying and sunlight. If some disinfectant is to be used choice may be had of a large number of chemicals, but some one must be selected that is suitable for that particular work. Any disinfectant that can be used in the form of a liquid may be applied in the form of a spray or by means of a broom or mop. A one per cent solution was used in all of the laboratory tests and this strength was found to be effective in most cases but the work was done under very different conditions from those usually met with in actual practice. To disinfect a stall, harness, or wood work of any character, a two per cent solution should be used and sufficient fluid applied to thoroughly wet the material to be disinfected. When a lot of any considerable size becomes infected it is not practicable to attempt disinfection by using any chemicals. The amount of material required to make the work thorough would be too expensive. Exception might be made where very small enclosures such as small chicken runs etc., become infected.

As has been mentioned before, to make use of these preparations in actual work, it is recommended to use at least a two per cent solution. To make this would require one gallon of the dip to 49 gallons of water or larger amounts could be made in the same proportion. For small amounts use one ounce of the dip to three pints of water.

The first tests were made in September 1903 and all of the dips tested, with the exception of Mortipest and Kerosene emulsion, proved to be effective. Some of the tests were not completed until about six months later when it was found that the Lincoln Dip had practically lost its disinfecting power. This will be seen by referring to table No. 4.

The following is a list of the dips tested, their manufacturers, and market price of the dips as given in their advertising matter.

*Zenoleum.* Zenner Disinfecting Co., Detroit, Mich. Price per gallon, $1.50, in 50 gallon barrels $1.00 per gallon.

*Cremoline.* Cremoline Mfg. Co., St. Louis, Mo. Price per gallon $1.50.

*Lincoln Dip.* Pasteur Vaccine Co., Chicago, Ill. Price per gallon $1.50.

*Car-Sul.* Moore Chemical Mfg. Co., Kansas City, Mo. Price per gallon $1.50.

*Moore's Hog Remedy.* Moore Chemical Mfg. Co., Kansas City, Mo. Price per gallon $2.50.

*Chloro-Naptholeum.* West Disinfecting Co., New York, N. Y. Price per gallon, $1.50.

*Mortipest Sheep Dip.* W. J. Bush & Co., 5 Jones Lane, New York, N. Y. Price per gallon $6.00.

For those who are familiar with bacteriological work the tables showing the disinfecting properties of the various preparations are sufficiently conclusive but it is well to add a brief summary of the general conclusions reached.

When the various coal-tar dips were used in a one per cent solution they were effective disinfectants in laboratory experiments but in practical work at least a two per cent solution should be used.

They were equally as good and in some of the tests proved to be better disinfectants than carbolic acid when used in the same strength.

The coal-tar dips tested are non poisonous and are not irritating to the skin or when used in wounds. As compared to carbolic acid they were certainly as effective, are cheaper and are not so dangerous to use.

The coal-tar preparations tested are not only good disinfectants but are also good deodorizers.

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BULLETIN NO. 63, MAY 1904.

# TUBERCULOSIS IN HOGS.

There has been considerable experimental work done to prove the transmissibility of tuberculosis from cattle to other animals. This work has been carried on principally with hogs and smaller experimental animals, such as rabbits, guinea pigs, etc. Sufficient experimental work has been done in this line to prove conclusively that hogs are easily infected with the disease. This is demonstrated when hogs are inoculated with tuberculous material from diseased cattle or when they are fed milk containing the tubercle germs. When the virulence of the tubercle germs from the human being and cattle is compared by inoculating them into the lower animals, such as hogs or rabbits, it is found that the germs from cattle are much more virulent as a rule than those obtained from man, and in nearly all cases where cultures of germs from cattle are used either for inoculation or feeding experiments the result is to produce tuberculosis in the hog.

Tuberculosis has long been considered a very dangerous disease among cattle and much time and money has been expended in studying it; while on the other hand very little attention has been given to the fact that the disease is present to a very great extent among hogs. The presence of the disease among hogs must necessarily follow where the disease is present in cattle, on account of the very general practice of feeding milk to hogs. This practice is common to some extent in all localities, but to a much greater extent in dairy districts on account of feeding skim milk.

In May, 1901, the tuberculin test was applied to the college herd, and two of the cows were found to be tuberculous, as they gave a very positive reaction to the test. One of the cows was not giving milk at the time but the milk from the other was fed to a number of pigs in order to see if the milk contained the germ of the disease. Afterwards some of these hogs were tested with tuberculin and post mortem examinations made. The results obtained are very conclusive, so far as demonstrating the presence of the tubercle germ in the milk is concerned, as well as showing hogs to be generally easily infected. If the milk of all cows that respond to the tuberculin test could be similarly tested, it would give a fair idea of the per cent of diseased cows that would be capable of scattering infection through the milk. In an experiment conducted by the Bureau of Animal industry it was found that during the entire experiment the milk of 21.4 per cent of the diseased cows contained virulent tubercle germs, as was proven by feeding the milk to small experimental animals.

Hogs are very susceptible to tuberculosis and may be easily infected by tubercle germs of either human or bovine origin. According to experiments conducted by Dinwiddie, hogs are more easily infected by germs of human origin than are any other domestic animal, while all of the species of domestic animals usually experimented on are easily infected by tubercle germs obtained from cattle.

There has been a great deal of discussion for the past few years as to whether tuberculosis was transmissible from cattle to man by means of either the meat or milk. The announcement made by Koch that the disease was not transmissible awakened new interest in the subject and has stimulated investigation along every line that was open to experimental work. Possibly a majority of those whose knowledge of the subject entitled them to consideration were from the outset opposed to Koch's view, and since the very essential basis of Koch's announcement has been proven to be untrue, a great many have supported the theory of the transmissibility of the disease from cattle to man, who were before in doubt. In Koch's paper on the subject of transmission of tuberculosis from cattle to man, he records a number of experiments where he inoculated cattle with tubercle germs of human origin and sums up the result of his experiments as follows: "So the animals we experimented on were affected by the living bacilli of human tuberculosis exactly as they would have been by dead ones—they were absolutely insusceptible to them." As is indicated by the above, Koch does not believe tuberculosis of man is transmissible to cattle, but results obtained by other experimenters are directly opposed to such a conclusion. Cultures of human origin have been inoculated into cattle so frequently and the results have been so uniformly successful in causing the disease that the question of transmission of the disease from man to cattle can hardly be said to be in dispute. Experiments carried on by Klebs, Kitt, Bollinger and others all confirm this view. If the experimental evidence points to the conclusion that the disease may be transmitted from man to cattle or the reverse it is as reasonable to conclude that other of the lower animals such as the hog may infect man through diseased meat. While recent experiments have added much to our knowledge of the subject, the fact remains that to prove conclusively that tuberculosis is transmitted from lower animals to man would require direct experimentation on man, but until there is absolute proof to the contrary, the great majority of investigators will always hold that tuberculosis is transmissible by means of meat and milk from the food animals to man. Since, in all probability, such views are correct, we should know that cattle and hogs used for food are as free from tuberculosis as they are from other forms of disease. The importance of the subject to agricultural interests cannot be over estimated. The disease among cattle has long occupied public attention and has been the cause of great loss to this branch of agriculture and if, through the milk of tuberculous cows, another food animal becomes diseased, the question is of still greater importance to the stockman and packer as well as to the consumer.

Very little interest is manifested in regard to the prevalence of tuberculosis among hogs, but it is becoming a very important disease and measures calculated to reduce its prevalence should be taken. Statistics furnished by meat inspectors at the various abattoirs, and published in the last three reports of the Bureau of Animal industry, indicate the general prevalence of the disease as well as show that it is becoming more prevalent. The figures indicate the number of post mortem inspections and the number of carcasses and parts of carcasses condemned at official abattoirs.

In 1900, 23,428,996 hogs were inspected; 4,379 entire carcasses and 1,061 parts were condemned.

In 1901, 24,720,482 hogs were inspected; 8,650 entire carcasses and 44 parts were condemned.

In 1902, 25,311,781 hogs were inspected; 14,927 entire carcasses and 4,700 parts were condemned. This loss from inspection at the abattoir is greater than that of any other disease except hog cholera and swine plague combined, the loss by inspection from these two diseases being in 1902, 16,980 head.

In this experiment the milk was fed to the pigs in considerable quantities for about two months. A portion of the hogs were tested with tuberculin, the first test being made in May, the others were made at intervals following this as shown by the tables. On May first, one of the hogs died, and a post mortem examination showed the cause of death to be generalized tuberculosis. Notes taken at that time are as follows: Male pig, weight about 150 pounds, physical condition fair. Tubercles were abundant in liver, spleen and lymph glands. The lungs were almost a solid tubercle. Adhesions over a large part of the pleural surfaces.

The appearance of the lesions of tuberculosis differs in the hog from the general appearance seen in cattle. In the hog the tendency is almost without exception to undergo calcareous degeneration. In none of the cases examined were the tubercles in a condition to break down and cause cavity formation. In the one case that died from the effect of the disease the lungs were almost a solid mass of tubercles and in the center of some of these there was a purulent-like material. When the knife is passed through the tubercle there is a gritting sound as if the tissue was filled with sand, and in alcoholic specimens it is necessary to infiltrate and work as soon as possible in order to section for microscopic examination. In a few instances abscesses were found near the surface of the body and these were filled with a yellowish-white pus which in one case had become dry and hard. The external appearance of the tubercle is about the same as is seen in cattle and they are generally found in the same tissues, although in the hog they appear to be more common in the spleen and lymphatic glands than in the lung and liver. The submaxillary glands were found to be diseased in every animal showing tubercular lesions in other parts of the body and in several where the disease could not be found except in these glands. They were sometimes enlarged to the size of a walnut or even larger and always showed, when opened, the yellowish calcareous material so characteristic of the disease. The spleen was found diseased in the majority of cases, the tubercles generally having the appearance of small yellowish or white bodies slightly raised above the surface of the organ. The lymphatic glands near the entrance of the esophagus into the stomach and those of the mesentery were generally found to be diseased.

The effect of tuberculosis on the physical condition of these hogs was not very marked. Some of the animals that showed a generalized condition of the disease at the time of post mortem examination had the disease almost a year, and they were in apparent good physical condition. In the one that died from the effect of the disease, the physical condition was not such as to cause suspicion of generalized tuberculosis. In fact, the entire lot of diseased hogs were in a marketable condition so far as flesh was concerned, and a number of them were killed under official inspection, their condition being such that they were considered fit for market. Forty-four hogs were subjected to official inspection at the abattoir and twenty-one, or 47.72 per cent of them were condemned as tuberculous. None of them were subjected to the tuberculin test.

The test with tuberculin was made in order to determine the value of this agent in diagnosing tuberculosis in hogs. Very few tests of this character have been made and it is desirable to know if tuberculin can be used to diagnose the disease in hogs with the same success as it is used to determine the presence of the disease in cattle. In order to save handling and consequently worrying the hogs every time the temperature was taken, they were kept confined in shipping crates. Even with this precaution the scuffling and worry of the animal often caused a rise of temperature of from one to three degrees. From the experience gained in this test it is evident that the temperature following the injection of tuberculin can not be relied upon always to indicate whether the animal is tuberculous or not, especially when the work is done in warm weather or when the hogs are not accustomed to being handled. It was found by actually testing the temperatures that the least excitement or worry would cause a rise of temperature. When the test was made that is recorded in table number three, the weather was cool and all of the hogs were very quiet as a rule and the temperature readings were about as they might be expected to run under favorable conditions. By comparing the post mortem notes with the temperature readings it will be seen that all of the animals showing a rise of temperature were not diseased, but on the other hand, no animal was found diseased that did not show a rise of temperature after the tuberculin was injected.

The hogs that were killed under official inspection at the abattoir were killed in two lots, one in January and the other in April, 1902. These hogs were from seven to ten months old. Those that were tested with tuberculin and killed at the college were examined during May and June, as shown by the tables. The entire number of hogs killed and inspected that belonged to the infected lot were 55, and of this number

26, or 47.2 per cent were found to be tuberculous on post mortem examination.

The large number of pigs exposed to the infection gives a better idea of the per cent of animals that may be expected to contract the disease than can be had when a few pigs are used, either for the purpose of feeding milk containing tubercle germs, or for inoculation with pure cultures. From the entire experiment it seems reasonable to conclude that 45 per cent, or more, of young pigs may be infected by feeding milk containing the virulent germs of bovine tuberculosis.

### TABLE No. 1--TEMPERATURES.

| BEFORE INJECTION | | | | | | AFTER INJECTION | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| May 2, 1902 | 1 | 2 | 3 | 4 | 5 | May 3, 1902 | 1* | 2* | 3 | 4 | 5 |
| 2 p. m. | 105. | 104.8 | 105. | 104.6 | 104.2 | 7 a. m. | 103. | 104.6 | 101.4 | 102.8 | 102.4 |
| 5 p. m. | 103. | 103.4 | 102.2 | 102.4 | 102.8 | 9 a. m. | 102.6 | 104.8 | 101.8 | 101.2 | 101.4 |
| | | | | | | 11 a. m. | 102. | 104.8 | 102. | | 101. |
| | | | | | | 1 p. m. | 102.4 | 106. | 103. | | 100.8 |
| | | | | | | 3 p. m. | 103.2 | 105.8 | 103. | 101 8 | 101.8 |
| | | | | | | 5 p. m. | 104. | 106.1 | 104. | 102. | 102. |
| | | | | | | 7 p. m. | 104. | 106. | | | |

Hogs were worried in getting them into the crates, this accounts for the high temperatures at 2 p. m. on May second. They were injected with tuberculin at 12 p. m., May second, each animal receiving one and one-half cc of tuberculin that had been in the laboratory about one year.

Number four broke out of crate, which acconuts for the blanks at 11 a. m. and 1 p. m.

## POST MORTEM NOTES.

*Found tubercular on post mortem examination.

May 6. Killed number two. Black sow, weight about 150 pounds, physical condition good. A generalized tubercular condition was found. Lymph glands of neck, chest, mesentery, and glands at entrance of esophagus to stomach were found enlarged and tubercular. Abundant tubercles in liver, spleen and lungs. The tubercles in liver were very small but abundant. Tendency to calcareous degeneration noticed in nearly all of the tubercles.

May 6. Killed number one at butcher's pen. Spotted pig, male, weighing about 150 pounds. Generalized tubeculosis, more advanced case than number two. Lungs were badly involved, showing fibrinous adhesions to chest wall. Spleen, liver, and lymph glands all showed marked tubercular lesions. The butcher was ordered to return the meat to the experiment station.

May 6. Killed number four at butcher's pen. Close inspection failed to show any tubercular lesions.

May 7. Killed No's. three and five. No tubercular lesions could be found in either animal.

## TABLE No. 2--TEMPERATURES.

BEFORE INJECTION

| May 15, 1902 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| 1:30 p. m. | 106. | 104.8 | 106.6 | 106.2 | 103. | 103. | 105.8 |
| 3:00 p. m. | 106.8 | 105.2 | 107.2 | 107.2 | 102.6 | 102.4 | 106. |
| 5:00 p. m. | 106 6 | 104.2 | 107.4 | 107 4 | 102.4 | 103. | 106. |
| 8:00 p. m. | 106.4 | 103.8 | 107 6 | 107.4 | 101.8 | 102.8 | 105. |
| 10:00 p. m. | 106.2 | 103.8 | 107.8 | 107. | 102.4 | 102.8 | 104 4 |
| 11:30 p. m. | 105.4 | 103 4 | 107.2 | 106.8 | 101.8 | 104.2 | 103.4 |

AFTER INJECTION

| May 16, 1902 | 1* | 2 | 3* | 4* | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| 7:00 a. m. | 103.4 | 102.8 | 104.8 | 105.2 | 101.4 | 102.8 | 103.4 |
| 9:00 a. m. | 104.5 | 104.2 | 105. | 105.6 | 102. | 103.8 | 104.4 |
| 11:00 a. m. | 105.4 | 104.2 | 105.4 | 105.8 | 101.8 | 103.2 | 104.6 |
| 1:00 p. m. | 106. | 105 4 | 106. | 106.2 | 102.8 | 103.8 | 107. |
| 3:00 p. m. | 106.6 | 104.2 | 106.2 | 106.4 | 102.4 | 104. | 107. |
| 5:00 p. m. | 107. | 104.6 | 106.4 | 106.6 | 102. | 104.6 | 107.4 |
| 8:00 p. m. | 106.4 | 103.4 | 106.6 | 104.4 | 102.2 | 103.6 | 107.4 |
| 10:00 p. m. | 106.2 | 104.2 | 106.2 | 105.4 | 102.6 | 100.8 | 107.2 |
| 11:00 p. m. | 105.4 | 104. | 106. | 105.6 | 101.8 | 101.8 | 107. |

Tuberculin was injected at 12 p. m., May 15. Each hog received one and three-fourths cc.

### POST MORTEM NOTES.

*Found tubercular on post mortem examination.

June 2. Killed number one. Liver, lungs and spleen show small tubercles. Large tubercles in lymph glands of chest.

June 2. Killed Number two. No tubercular lesions.

June 2. Killed number five. No tubercular lesions.

June 7. Killed number four. Lymph glands of neck found tubercular. No other tubercles found in the body.

June 8. Killed number seven. No tubercular lesions.

June 16. Killed number three. Lymph glands in the neck tubercular. No other tubercles found in the body.

June 16. Killed number six. No tubercular lesions.

Number seven was a large breeding animal and was not exposed to infection in any way, and is not included in calculating the per cent of diseased hogs.

### TABLE No. 3--TEMPERATURES.

| BEFORE INJECTION | | | | | AFTER INJECTION | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Oct. 28, 1902 | 1 | 2 | 3 | 4 | Oct. 29, 1902 | 1 | 2 | 3 | 4 |
| 5:30 p. m. | 102.6 | 101.4 | 103.4 | 104.4 | 8:00 a. m. | 101.5 | 99.6 | 102.1 | 102.8 |
| 7:30 p. m. | 103.4 | 100.6 | 102.8 | 102.8 | 10:00 a. m. | 100.6 | 99.6 | 102.4 | 102.6 |
| 9:30 p. m. | 103.4 | 100.4 | 103.2 | 102. | 12:00 a. m. | 100.4 | 99.6 | 102. | 101. |
| 11:30 p. m. | 101.6 | 100.4 | 103.2 | 101.8 | 2:00 p. m. | 100.8 | 99.8 | 101.4 | 101. |
| | | | | | 4:00 p. m. | 101.1 | 99.2 | 102.2 | 104.* |
| | | | | | 6:00 p m. | 100.8 | 99.4 | 102.4 | 102. |

*High temperature due to recrating animal after it had broken out.

The high temperatures before injection was due to worrying the animals while crating them. Each animal was injected at 12 p. m., with 2 cc of fresh tuberculin.

None of the above animals were fed any of the milk from the tuberculous cow, but they had been in pens with the diseased hogs for several weeks and the test was made to see if any would react. The negative diagnosis of tuberculosis could not be confirmed by post mortem examination as none of the hogs were killed.

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# OKLAHOMA AGRICULTURAL EXPERIMENT STATION

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